

MiG-29 Fulcrum

in action

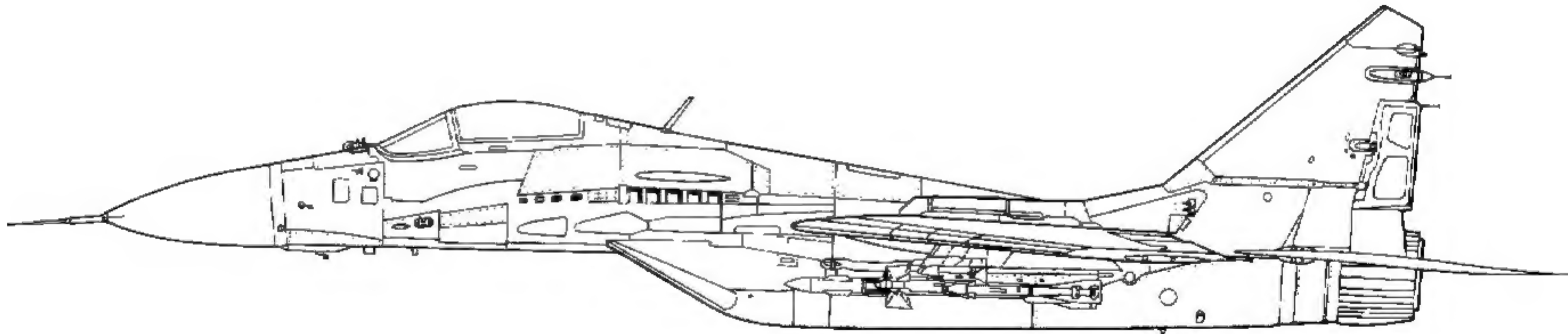


Aircraft Number 112
squadron/signal publications

MiG-29

Fulcrum
in action

By Hans-Heiri Stapfer
Color By Don Greer
Illustrated by Joe Sewell



Aircraft Number 112
squadron/signal publications



Iraqi Air Force MiG-29 Fulcrum As flew top cover for Iraqi forces engaged in the invasion of Kuwait on 2 August 1990. Although opposing aircraft reportedly sighted each other, there were no known air-to-air engagements between Iraqi and Kuwaiti fighters.



MiG-29

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Dedication

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This MiG-29 Fulcrum A is flying over the rugged mountains of Canada enroute to the Abbotsford International Air Show at Vancouver, British Columbia. Earlier this MiG-29, along with a MiG-29UB Fulcrum B, made a four hour layover at Elmendorf AFB, in Alaska. (Canadian Forces Photographic Unit)



Introduction

The MiG-29 Fulcrum made its Western public debut during the Summer of 1986 and has since become one of the best known Soviet fighters. With the advent of the MiG-29, the Soviets had a fighter that was not only equal in performance and handling to Western aircraft, it was in some areas superior. As part of President Gorbachev's *Glasnost* policy, MiG-29s have made a number of appearances in the West.

The requirement for a new generation of combat fighters, a requirement that would eventually lead to the MiG-29 and Su-27, was issued by the Kremlin during the late 1960s. The Soviet Ministry of Defense issued the general design layouts for two different sized fighter aircraft. The Sukhoi design bureau was entrusted with the development of the larger aircraft, a long range interceptor intended for the Soviet Air Defense Force (PVO). This project was called T-10 by the Sukhoi design bureau and later emerged as the Su-27 Flanker, which is considered to be the Soviet counterpart of the F-15 Eagle.

The second requirement was for a frontal (i.e. tactical) fighter for the Frontal Aviation Regiments of the Soviet Air Force (VVS). This task was assigned to the MiG Design bureau (MiG-OKB). MiG is actually an acronym for Mikoyan i Gurevich (the i meaning "and" in Russian). Additionally, "mig" in colloquial Russian also means "in no time" and is a slang term for speed.

Since the Great Patriotic War (the Soviet name for World War II) the MiG-OKB has used a letter or letter-digit code for new projects. For example, the project designation for the MiG-15 was S, while the MiG-19 was coded M. The Soviet Air Force and the aircraft industry use another code system, referring to new aircraft as Product numbers: the MiG-25 Foxbat was known as Product 84. The Product number for the MiG-29 remains one of the secrets kept by the Soviets. The designation MiG-29 is used as a public designation and does not appear in official documents. Additionally, only aircraft types put into full production receive the MiG prefix.

Both design bureaus, MiG and Sukhoi, closely watched the rapid development of the new generation of Western combat aircraft, such as the F-15 and F-16. Whenever technical data became available (either from legal or illegal sources) it was quickly investigated by both bureaus and a number of other Soviet institutions.

Both design bureaus received considerable technical assistance from the Central Aero-Hydrodynamic Institute (TsAGI), located in Zhukovskii; in fact, most of the design work on the wings was done by TsAGI specialists. Scale models and later full-sized prototypes were also tested in the twelve by twenty-four meter (thirty-nine by seventy-nine foot) wind tunnel at the TsAGI.

The Soviets also studied a number of intact Western aircraft after the fall of South Vietnam during 1975. The following aircraft were flight tested by a Soviet Air Force special evaluation group known as the I.D.K.: F-5E, A-37B and C-130 Hercules. This same organization had also evaluated an F-86 Sabre captured in Korea. All the aircraft were flown in full Soviet markings.

As the development of the two designs entered the flight test stage, the Soviets acquired a number of F-4 Phantoms, at least one F-14A Tomcat and some AIM-54 Phoenix air-to-air missiles from Iran. It is doubtful that these aircraft were flight tested at Ramenskoye; however, a single F-4 was seen at Astrochan Air Force Base, a large Soviet training area similar to Nellis AFB in Nevada.

Technology obtained from these aircraft was incorporated into the new fighter designs. Additionally, the Aero company of Czechoslovakia evaluated a damaged F-5 (obtained from Vietnam) and information from this evaluation was used to improve the

Aero L-39 trainer. Poland evaluated two non-flyable types at the *Instytut Lotnictwa* (Aviation Institute), an F-5 and A-37. The results of this evaluation allowed the Polish State Aircraft Factory (PZL) to improve their designs, with the F-5 having a great influence on the design of the I-22 trainer.

Sukhoi began design work during 1969, three years ahead of the MiG OKB, although both prototypes were completed and flown during 1977. The first to fly was the T-10 (Su-27) which made its maiden flight on 20 May with chief test pilot Vladimir Sergejevich Iljushin at the controls. The MiG design followed during October of that year.

The new fighter was a challenge for the MiG-OKB. The requirement stated that it had to have similar or better performance than any Western fighter under development. It was also the first aircraft designed since the death, during 1970, of Artyem Mikoyan (his partner Gurevich had retired during 1964). Additionally, this was the first time a MiG fighter would be powered by a turbofan engine, rather than a less sophisticated turbojet. Also, the new fighter would be the first MiG to be equipped with a look-down/shoot-down radar, enabling the aircraft to track and engage targets below its own altitude.

Work on the project began during 1972 under the leadership of General Designer Rostislav Belyakov. While the first drawings for the MiG-29 were being completed, the last variant of the Fishbed, the MiG-21bis-SAV entered production and the first production MiG-23s were undergoing Soviet Air Force operational evaluation.

One of the most critical areas of the MiG-29's development was the engine, which caused numerous problems during the testing of the prototypes and preproduction aircraft. The Izotov Design Bureau had been entrusted to develop the turbofan power plant for the MiG-29. Izotov was well known for their reliable helicopter engines used in the Mi-8 Hip and Mi-24 Hind helicopters.

In contrast to a turbojet engine, a turbofan engine requires more exotic materials and higher quality steel, technology that the Soviets had lacked for a long time. Additionally, a turbofan requires a higher degree of workmanship than a turbojet. As a result, the early RD-33 power plants in the MiG-29 prototype were far from reliable and caused major delays in the program.

The prototype was equipped with a radar system adapted from the radar in the MiG-23 Flogger, NATO reporting name High Lark. The J-band radar had a search/track range of forty miles and was considered an interim installation until the OI-93 (Slot Back) look-down/shoot-down radar was available.

Metal was cut on the first of two MiG-29 prototypes during 1976 at the State Aircraft Factory Number One at Frunze airfield northwest of Moscow. Since so many new engineering areas had to be covered, the relatively long development time of the MiG-29

MiG-29 Prototype 9.01 parked on the ramp in front of one of the hangars at Monino. The prototype featured rear fuselage ventral fins, a multi-position inlet ramp door and a nosewheel taken from a MiG-23. This aircraft is now on display at the Soviet Air Force Museum.



was not surprising. In parallel with the prototypes, a flying testbed with a much smaller wingspan (twenty-five feet) and a length of thirty-eight feet was built to evaluate the aircraft's characteristics in the more dangerous areas of the flight envelope.

During late Summer of 1977, the first prototype was completed and the aircraft was taken to The Zhukovskij Factory Test Complex at Ramenskoye Air Base for flight trials. Ramenskoye, about thirty miles southeast of Moscow, is the Soviet's major test and experimental field for new aircraft, similar to Edwards Air Force Base (USAF) or Boscombe Down (Royal Air Force).

Shortly after its arrival at Ramenskoye, the aircraft was spotted by a U.S. reconnaissance satellite and given the provisional reporting designation RAM-L (the prototype T-10 Su-27 was also spotted and named the RAM-K), RAM being an abbreviation of Ramenskoye. Shortly after Washington announced the existence of the RAM-L, Western press dubbed the aircraft the MiG-29, although it would take some nine years for the Soviets to confirm the aircraft's designation.

The first prototype, known as Aircraft 9.01, emerged as a twin engined, twin tailed, high wing fighter with a blended wing and lifting body type fuselage and bubble canopy. The twin engines were mounted in low nacelles which were pod like in their appearance. The wings were blended into the fuselage with long leading edge extensions (LEXs) that ended just behind the pointed radome. Prototype 9.01 was clean, lacking armament or weapons pylons and was intended to serve as a technology demonstrator. It was equipped with a KM-1 ejection seat adapted from the MiG-23 along with other components from the Flogger.

The air intakes are the most unique aspect of the MiG-29 prototype. The intakes are conventional multi-shock intakes optimized for high supersonic speeds. They are unique, however, in that they can be closed completely on the ground to avoid Foreign Object Damage (FOD) problems. The intake is closed off by a movable supersonic shock ramp, which can be lowered until it completely shuts off the air inlet.

The ramp is automatically lowered when the aircraft is taxiing. With the intake closed off, five air intake louvers mounted above the leading edge extension are opened to provide engine air. These louvers also open automatically whenever there is a disruption of main intake air, such as low speed, high angle of attack maneuvers.

The first prototype 9.01 took off for the first time on 6 October 1977, with MiG chief test pilot Alexander Vassiljevich Fedotov at the controls. Fedotov, had previously tested the MiG-23 and MiG-25 and held no less than eighteen records in various aircraft.

The second prototype joined the factory flight test program a short time later and these tests revealed that certain details of the basic design needed to be improved. One such improvement was the angle of the air intake duct, which was changed from a near vertical intake to a sharply raked back intake, to improve airflow at high angles of attack.

Throughout the factory trials the two prototypes were refined and modified; however, the main weak point continued to be the RD-33 engines. The second prototype, Product 9.02, was lost due to an engine failure. Alexander Fedotov was conducting a test flight at 3,000 feet and a speed of 1,300 kilometer per hour (808 mph) when an explosion caused an engine to catch fire. As a result, Fedotov was forced to eject. Shortly after this a second MiG test pilot, Valerij Jevgenjevich Menitskij, joined the test program.

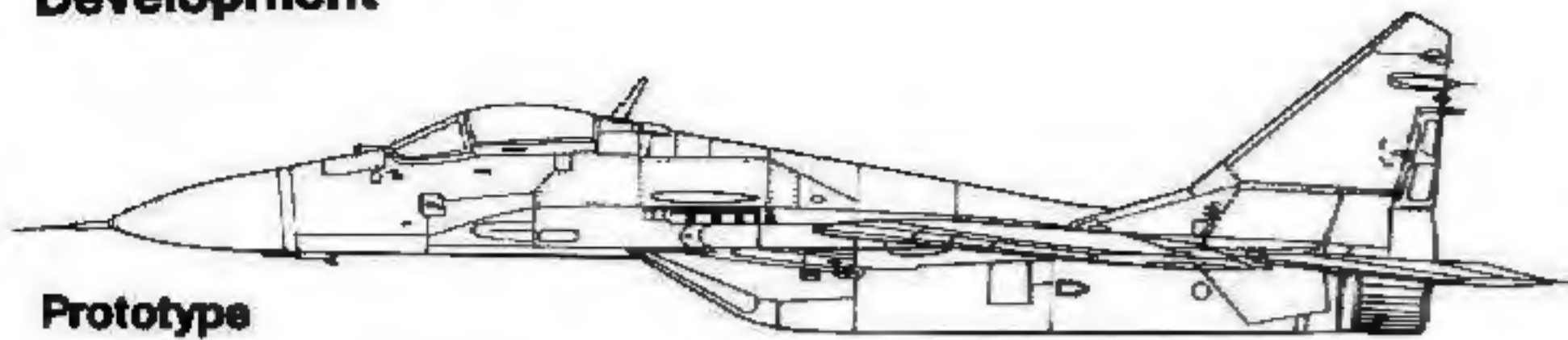
The prototype flight tests provided the MiG-OKB with valuable data and gained for them approval for twenty preproduction aircraft. During 1987, the first prototype, 9.01, was put on display at the Air Force Museum at Monino near Moscow.

Even before the aircraft had entered operational service, NATO's Air Standards Coordinating Committee (ASCC) had assigned the MiG-29 the NATO reporting name — Fulcrum.

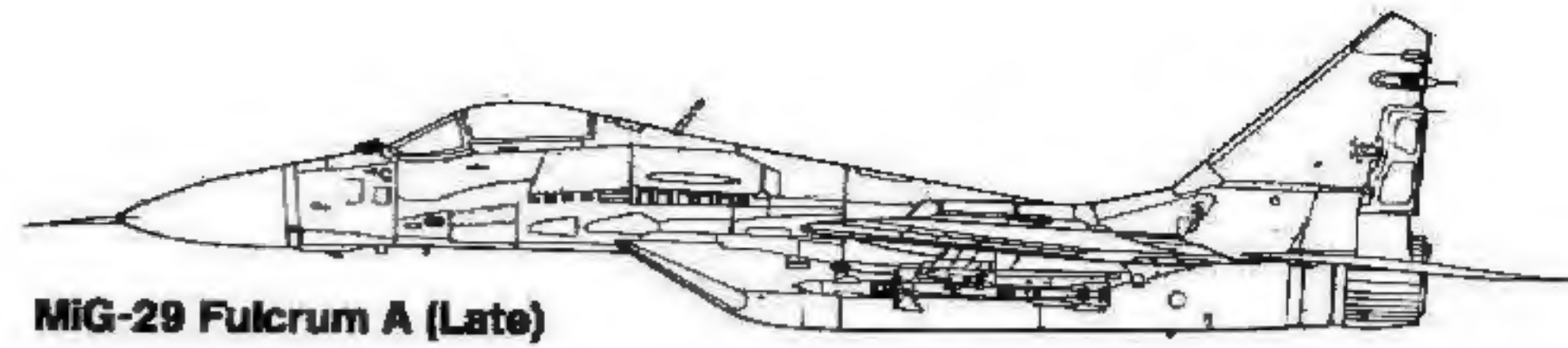


During 1988, the first MiG-29 prototype (Aircraft 9.01) was put on permanent display in one of the hangars at the Monino Museum. The radome on the prototypes was more conical in shape than on later MiG-29s. (Andras Nagy)

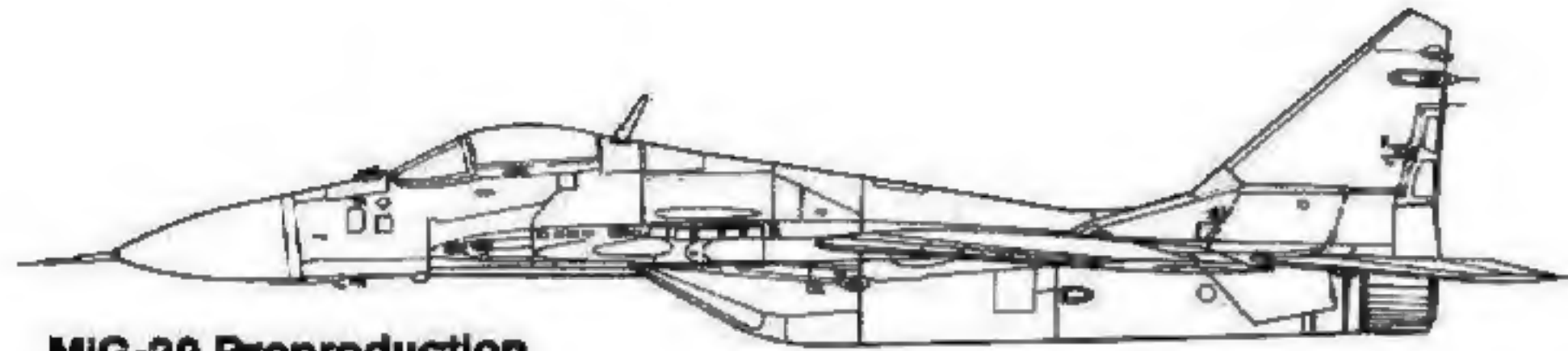
Development



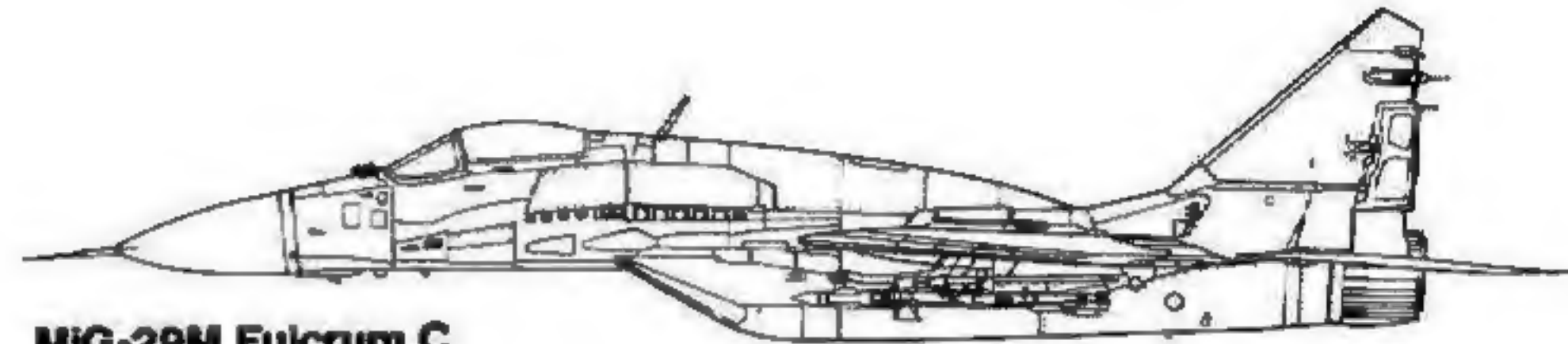
Prototype



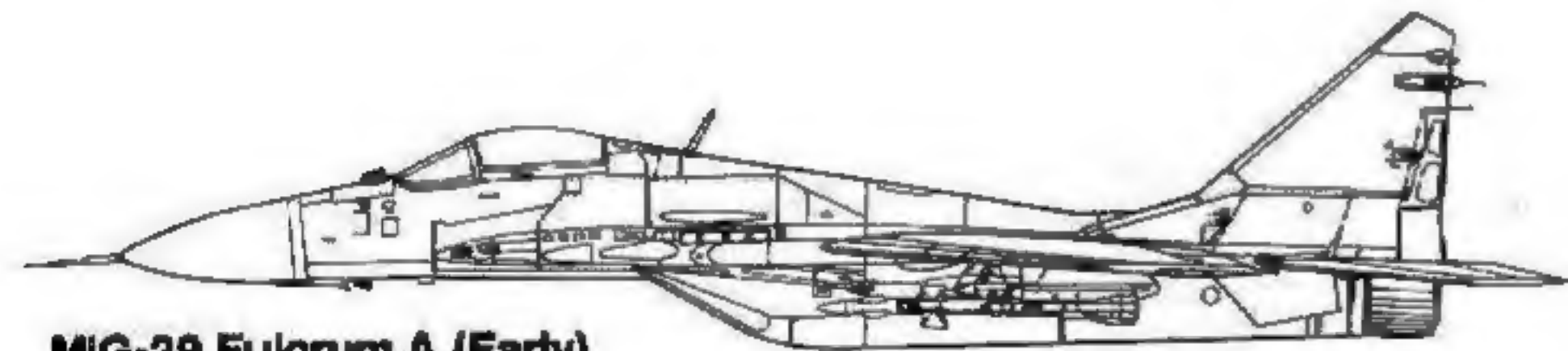
MiG-29 Fulcrum A (Late)



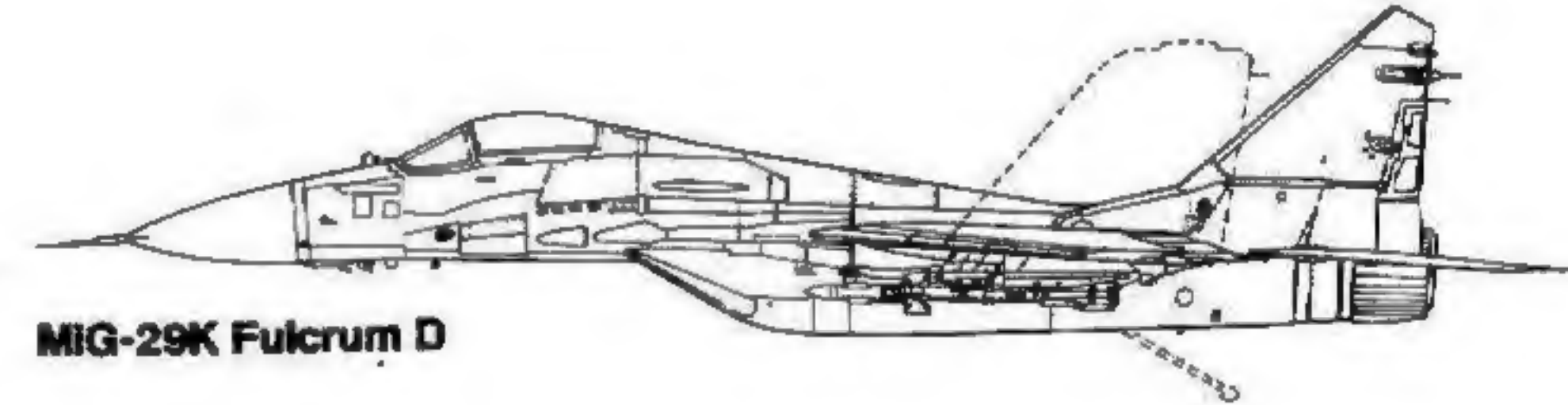
MiG-29 Preproduction



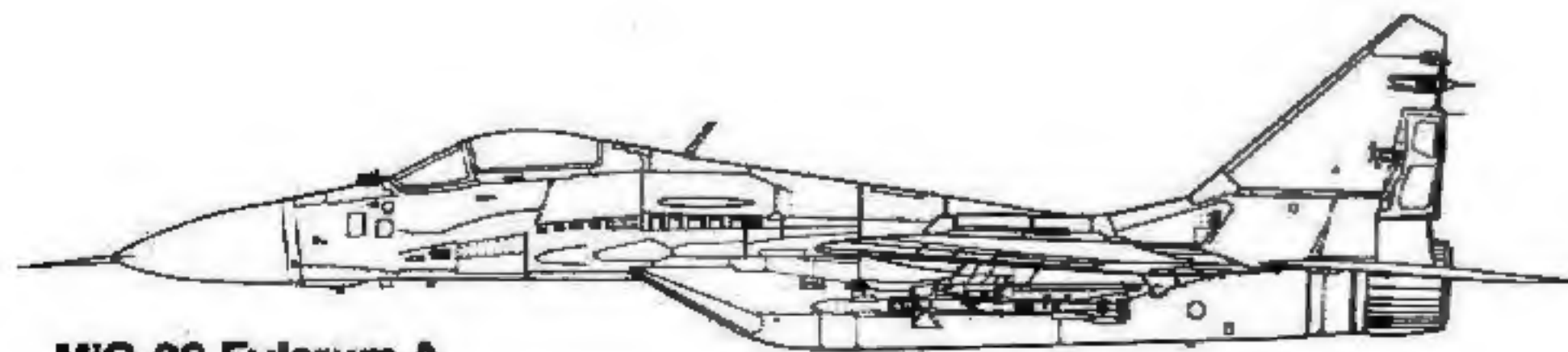
MiG-29M Fulcrum C



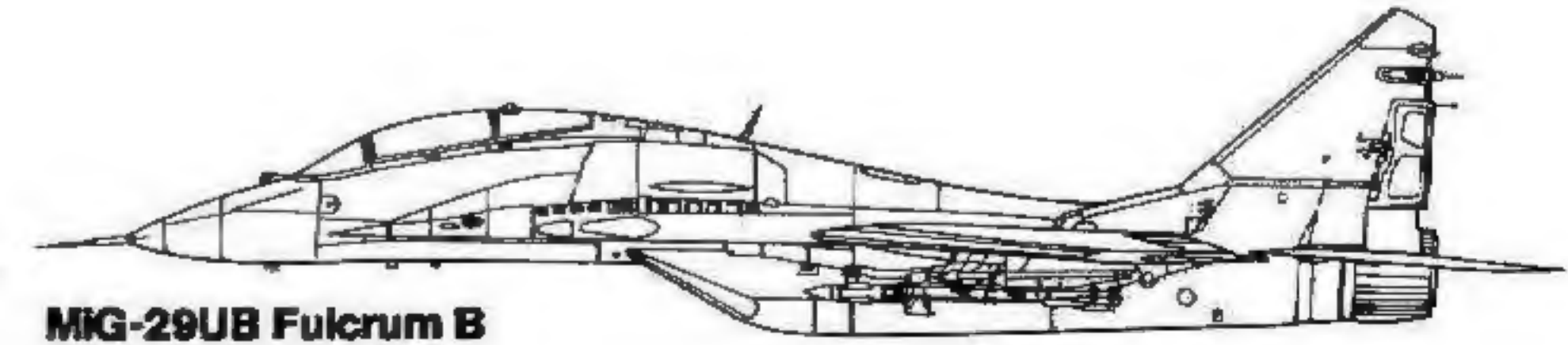
MiG-29 Fulcrum A (Early)



MiG-29K Fulcrum D



MiG-29 Fulcrum A



MiG-29UB Fulcrum B

MiG-29

Preproduction Aircraft

The factory flight testing of the two MiG-29 prototypes at Ramenskoye revealed that generally, the MiG-29 was a sound design; however, it had a number of shortcomings. To correct these, MiG-OKB general designer Rostislav Belyakov and his deputy Mikhail Valdenberg, began work on a series of improvements which were refined and tested by a preproduction run of twenty aircraft built at the State Aircraft Factory Number One at Frunze airfield.

These aircraft were built primarily as additional test and evaluation airframes (this was a common practice during this time period; for example, there were twenty-one prototype/preproduction F-14s built to speed up its test program). Once the factory flight tests were finished the aircraft was turned over to the *Lyeno Ispytatelnno Institut Grazhdanskoy Aviatsii* or LII-GA (Flight Experimental Institute of Civil Aviation). Here the state acceptance trials were conducted. Despite its name, the LII-GA conducts flight testing for both military and civil aircraft.

The LII-GA evaluates the aircraft's handling qualities and its behavior throughout the flight envelope with flight tests being carried out at Ramenskoye. In the case of the MiG-29, the factory and state acceptance trials ran for a time in parallel. This enabled LII-GA requests for design improvements to be turned over to the MiG-OKB quickly. Once completed, the improvements were tested by factory pilots before the aircraft was handed back to the LII-GA.

When the state acceptance trials were completed satisfactorily, the preproduction MiG-29s were handed over to the third and last organization responsible for the acceptance of a new design, the *Nautshno Ispytatelnno Institut Voenno Voorjzshennykh Sil Rabotsho Kriestnyanskoy Krasnoy Armii*, or NIIVSRKKA (Science and Experimental Institute of the Air Force).

The NIIVSRKKA is responsible for the evaluation of the aircraft under field conditions. NIIVSRKKA conducts all weapons trials, and tests the aircraft under operational conditions. Their evaluation decides if a new type of aircraft is cleared for use by the Air Force or if it is abandoned.

The operational test phase was done by a number of experienced Soviet Air Force pilots at Ramenskoye and other locations in order to test the reliability of both the airframe and other equipment. Based on these, a list of needed improvements was formulated. All these needed improvements were written down in an official log and submitted to the MiG-OKB for action.

The preproduction aircraft differed from the prototypes in a number of ways. A single GSh-301 30MM cannon was installed in the port wing root and six underwing weapons pylons. The nosewheel gear was relocated further back to prevent water, mud or snow from being thrown into the air intakes. The aircraft was fitted with Odd Rods IFF antennas mounted above and below the nose. The large HF antenna mast, carried on the pro-

totype just to the rear of the cockpit, was replaced with a smaller antenna which was relocated further back on the fuselage spine. A second, larger ECM antenna was carried on the port LEX behind the first ECM antenna and the angle of attack transmitter was repositioned slightly more forward on the fuselage side.

On the prototype, a position light with a blister fairing was mounted on the fin under the electronic blister, while on the preproduction aircraft the light was incorporated into the electronic blister. Additionally, the prototype rudder hinge was unfaired, while on the preproduction aircraft the hinge was fitted with a fairing to reduce drag. There were also modifications to the wing. The prototype lacked the radar warning receiver antenna on the wing tip and only had a single static discharger, while the preproduction variants had two dischargers on the wing tips. There were two static dischargers on the prototype's rudder, while preproduction aircraft carried only a single discharger.

At least three preproduction MiG-29s were lost during the trials. One of them, flown by MiG-OKB deputy chief test pilot Valerij J. Menitskij, suffered an engine failure and

One of the preproduction aircraft was used as an instructional aircraft at the Zhukovskii Air Force Academy. It has had the large HF radio antenna normally carried behind the cockpit removed. Preproduction aircraft were unique in that they had a cooling air intake on each upper engine nacelle. (Aviazija i Kosmonavtika)



Minitiskij was forced to eject. The other two aircraft were lost because of problems not directly related to the RD-33 power plants. The most spectacular crash occurred on 4 April 1984, apparently at the end of the MiG-29 evaluation trials. MiG chief test pilot Alexander Fedotov was killed flying either the seventh or eighth preproduction MiG-29 while conducting high angle-of-attack maneuvers. During one of these maneuvers both engines failed due to a lack of airflow in the intakes. Unfortunately, he was unable to restart the engines and he was killed trying to make a forced landing.

Unlike earlier MiG designs, the Soviets kept the MiG-29 project under strict security throughout the flight test program. With the MiG-21 and MiG-23 it had been the custom to publicly unveil the prototypes and preproduction aircraft within twelve months of the aircraft's first flight. The ultimate MiG-21 prototype first flew during early 1956 and was presented to the public at the Tushino Air Parade on 24 June 1956. The two MiG-23 prototypes were demonstrated at the Domodedovo Air Parade on 9 July 1967, some two months after their maiden flight. In the case of the MiG-29, however, the Soviets held off the public display and it was some nine years from the maiden flight of the MiG-29 until its official unveiling. The Soviets had kept the Fulcrum hidden from Western observers longer than any other type built in Soviet history.

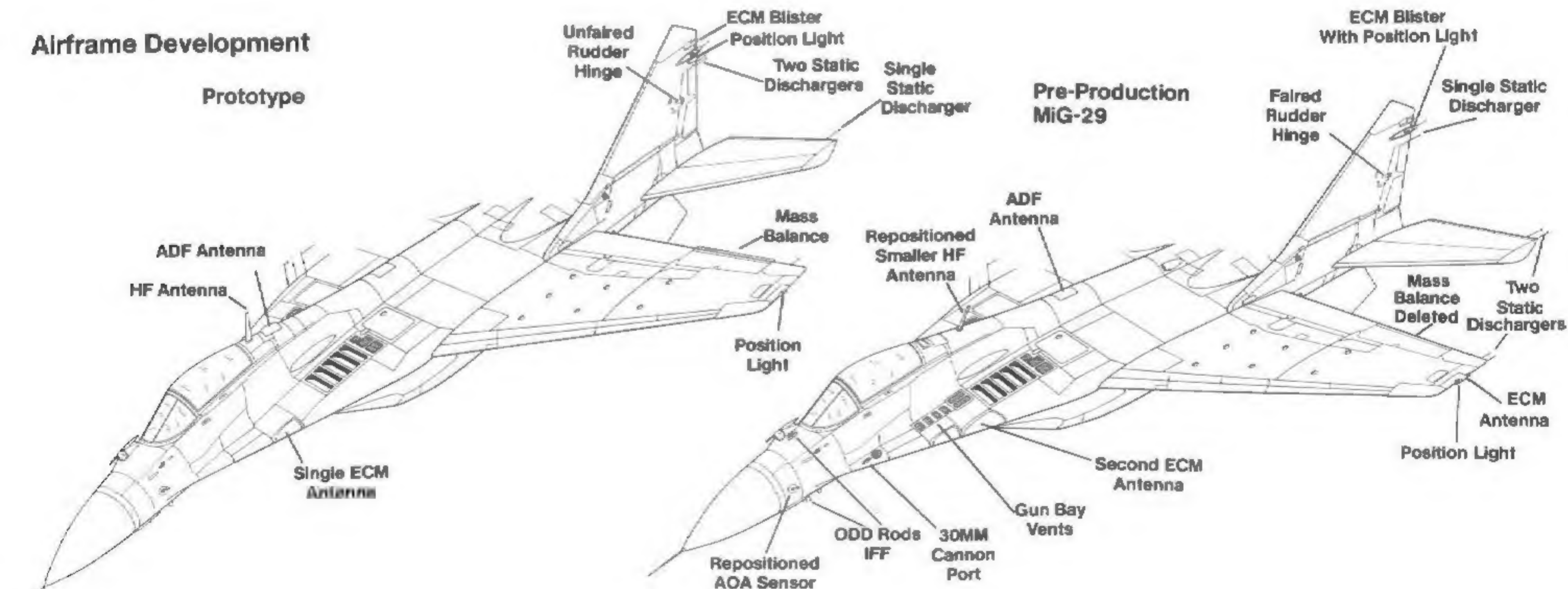


One of the preproduction MiG-29s during flight tests at Ramenskoye. The aircraft had the same ventral fins as the prototype and carried three non-standard weapons pylons under each wing. The rudder hinge on the preproduction aircraft differed from the prototypes in that it was faired over.

Airframe Development

Prototype

Pre-Production MiG-29



MiG-29 Fulcrum A (Early)

The first production MiG-29 rolled off the assembly line at Frunze during 1982 while flight tests with the preproduction aircraft were still underway. The Soviet Air Force had expressed an urgent demand for a new generation fighter since the West had already introduced fighters such as the F-15 and F-16 into operational service. The F-16 entered operational service with the 388th Tactical Fighter Wing at Hill AFB, Utah, during January of 1979 while the MiG-29 was still being flight tested.

As a result of the urgent demand, the head of the Ministry of Aviation Production, V.A. Kazakov, decided to begin production of the MiG-29 as soon as possible. Production was started at the Znamya Truda factory and, although most of the MiG-29's early problems had been corrected, there were still problems with the less than reliable RD-33 power plants.

The MiG-29 was essentially an aluminum aircraft, although basic construction quality standards were much better than with the earlier MiG-21 and MiG-23 fighters. Initially there had been some thought to the use of composite materials; however, the MiG-OKB had little experience with composites when it started development of the MiG-29. As a result, only a few parts are of these new materials. The skinning of the vertical tails and parts of the wing tips are made of carbon fiber composites and fiberglass is used for the vertical tail tips and for portions of the fuselage to the rear of the cockpit.

Metal honeycomb sandwich techniques are used for tailplanes and all control surfaces. The wing and tail spars, as well as most stressed fuselage frames are made of titanium alloys. The integral fuselage fuel cells are electron beam welded or argon atmosphere welded.

In sharp contrast to its Western counterparts, the MiG-29 has no fly-by-wire system. At the time the Soviets were developing the Fulcrum, they lacked experience in this field and preferred older, proven and reliable technology. The mechanical control systems, however, do feature a number of automatic features and redundant backup control channels.

The MiG-29 is the first Soviet aircraft to be equipped with a look-down/shoot-down radar system. This means that the aircraft's radar can track and engage targets, such as aircraft or cruise missiles, flying below the fighter's own altitude. The OI-93 radar (NATO reporting name Slot Back) is capable of searching eight miles above and four miles below the aircraft's flight level. In the search mode the radar can detect a target at more than seventy miles and track it at ranges exceeding fifty miles. The aircraft's fire control system is automated and capable of tracking ten targets at once. Once the target is within range, the weapons system will automatically select and launch the suitable missile. A comparison flight between a MiG-29 and F-16 was conducted in Germany. The test revealed that the OI-93 radar detected the F-16 earlier than the F-16's radar acquired the MiG-29.

A considerable amount of the OI-93 radar technology is based on Western technology obtained through both legal and illegal Soviet activities. A considerable boost in their development efforts was the supply of an AN/AWG-9 radar from a former Iranian F-14A. It is believed that the AN/AWG-9 radar system is the basis for the OI-93.

The early production aircraft were nearly identical to the preproduction aircraft except that the landing light was moved from low on the starboard side of the nosewheel strut to a position higher and on the port side of the strut. The radome was also slightly

This early production MiG-29 Fulcrum A is parked on the ramp of the Znamya Truda (Banner of Labor) factory, located at Frunze airfield northwest of Moscow. It has a non-standard nose-wheel door and is carrying a center-line fuel tank between the engine bays. (Jon Lake)



enlarged to accommodate the OI-93 radar. Additionally, the KM-1 ejection seat, also developed by the MiG-OKB was replaced by a more modern K-36DM ejection seat.

In the beginning there was strong opposition within the MiG-OKB to the installation of a new (and non-MiG-OKB) ejection seat in the MiG-29. The decision was made, however, to fit all production MiG-29s with the K-36DM ejection seat. This seat had been developed by a design team headed by Utkin Slevierin and was first introduced in the Sukhoi Su-24 Fencer. Since its service introduction, some 300 ejections have been performed and, of some 100 reported pilot ejections, ninety-seven survived without injury.

Early production MiG-29s also had a cooling air intake added on the port side of the rear fuselage. The two small air intakes mounted just ahead of the jet exhausts on the pre-production aircraft were deleted on the production aircraft. The speed brake jacks were enlarged and strengthened and the braking parachute was changed to the PTU-29 system, housing a tan colored parachute (in contrast to the White/Red parachutes used on the earlier MiG-21/23s).

The six underwing weapons pylons fitted to the preproduction aircraft differed in shape from the weapons pylons fitted to the early production aircraft. Like the preproduction Fulcrums, the production aircraft were armed with the GSh-301 single barreled 30MM cannon with 150 rounds of ammunition. Reportedly, the only disadvantage to this weapon is its low Time Between Overhauls (TBOs) of only 2,000 rounds. The gun was reportedly based on the highly successful 30MM 2A42 auto cannon which is fitted to the BMP-2 infantry fighting vehicle.

During operational testing, the GSh-301 had a number of teething problems. In air-to-air firing, the gun jammed after firing just four to six rounds — although in each case the target was shot down! Deputy General Designer Valdenberg stated that had he had known the weapon was so accurate, he would have specified only half the ammunition load of 150 rounds carried by the Fulcrum and saved the weight.

It is believed that this MiG-29 Fulcrum A was retained by the MiG-OKB for factory tests at Frunze. The two pitot tubes near the cockpit are non-standard items and the small rear view mirrors on the canopy railing were adapted from the MiG-23 Flogger series. (Jon Lake)



The various sensors, radar, infrared search/track (IRST) and laser ranging (LR) can all be used individually but are usually linked via the fire control computer to the Head Up Display (HUD). The IRST automatically locks on to any heat source within its field of view and the radar can be fed information from the IRST in the form of a false echo to allow the Fulcrum to make a non-emitting approach to the target. If the IRST/LR is blinded by cloud, the radar automatically switches to transmit. The radar is aligned automatically with the IRST (even when in standby) so that the target is kept within the radar's field of view.

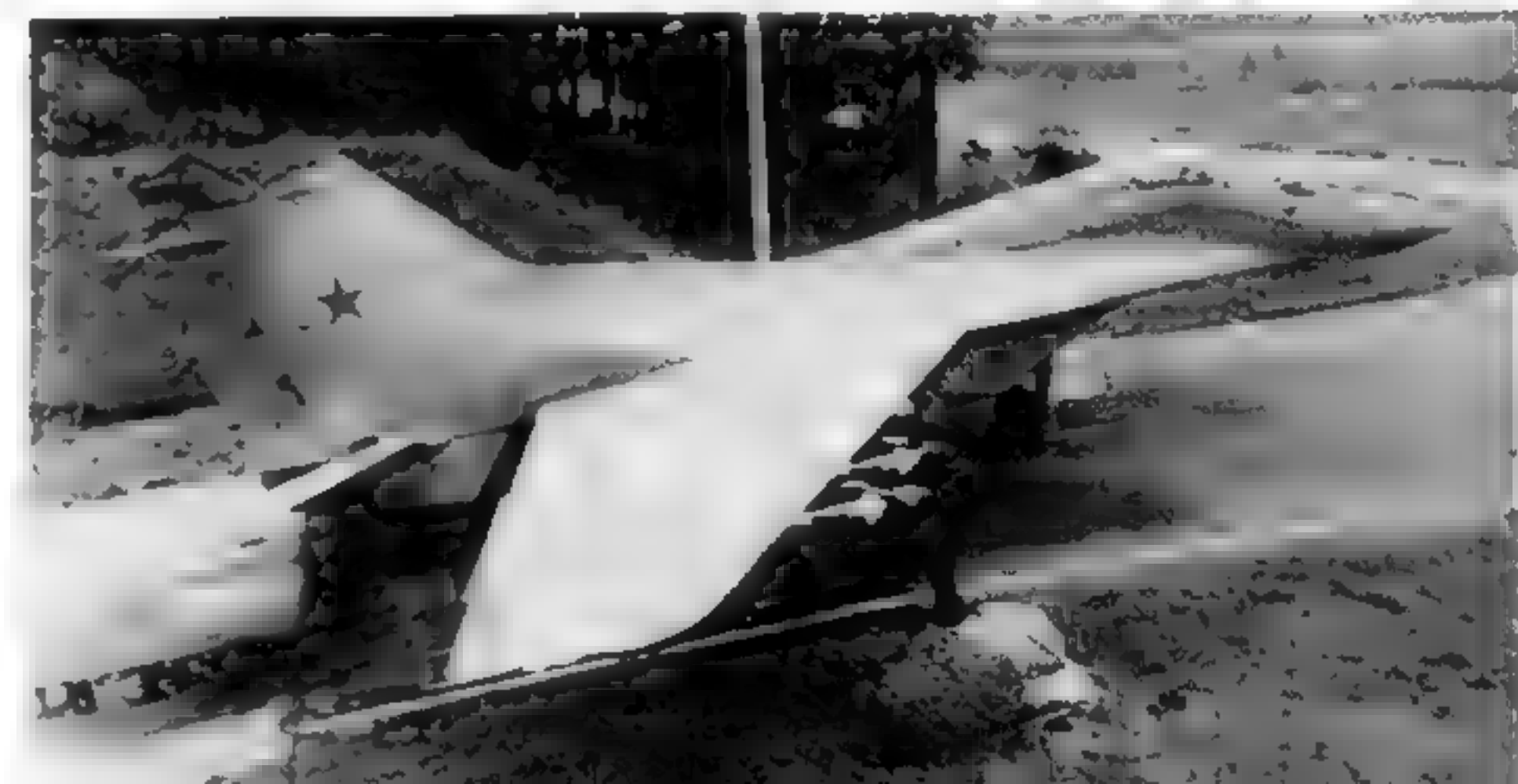
During the first production runs, these early production variants were progressively improved. While the first production blocks had a debris deflection cover fitted to the front of the nosewheel, it was deleted on later production blocks. This cover was also part of the nosewheel cover endplate when the nosewheel was retracted. When this cover was deleted, the nosewheel doors were enlarged. Some early production aircraft were fitted with a spray/debris guard on the nosewheel, although this was not fitted to all aircraft.

While most early production aircraft carry a three pole Odd Rods IFF antenna on the underside of the nose, there were a number of early MiG-29s later fitted with a blade style IFF antenna.

When the first early production aircraft were delivered during 1982, they were assigned to a test unit at Kubinka. This unit obtained its Initial Operational Capability (IOC) during 1983. Soon there were two MiG-29 regiments deployed in Military Districts within the USSR and, during January of 1986, the first twenty-three MiG-29s were deployed to East Germany as part of the Group of Soviet Forces, Germany. These were the first Fulcrums deployed outside Soviet territory and the two squadrons were based at Wittstock near Neubrandenburg, east of Berlin, near the Polish border.

During the early 1980s the Soviet Union drastically scaled down its annual production of combat aircraft. In 1981 some 1,350 aircraft were produced, two years later 950 were built and during 1985/86 only 650 combat aircraft left the various assembly lines. From the mid-1980s onward, the Soviet Union began a new doctrine of quality over quantity in aircraft production. As a result, there were relatively few early production Fulcrums produced (approximately 100) before production switched to an improved and standardized variant of the MiG-29 during 1984.

Blue 42, an early MiG-29, undergoes preflight at Kubinka Air Force base. The nets in the foreground were used to camouflage the White R-73 air-to-air missiles on the outboard pylons while the aircraft was on the ground. Although the ventral fin identifies this aircraft as an early MiG-29, it appears to have been retrofitted with a blade type IFF antenna under the nose. (Steven Zaloga)

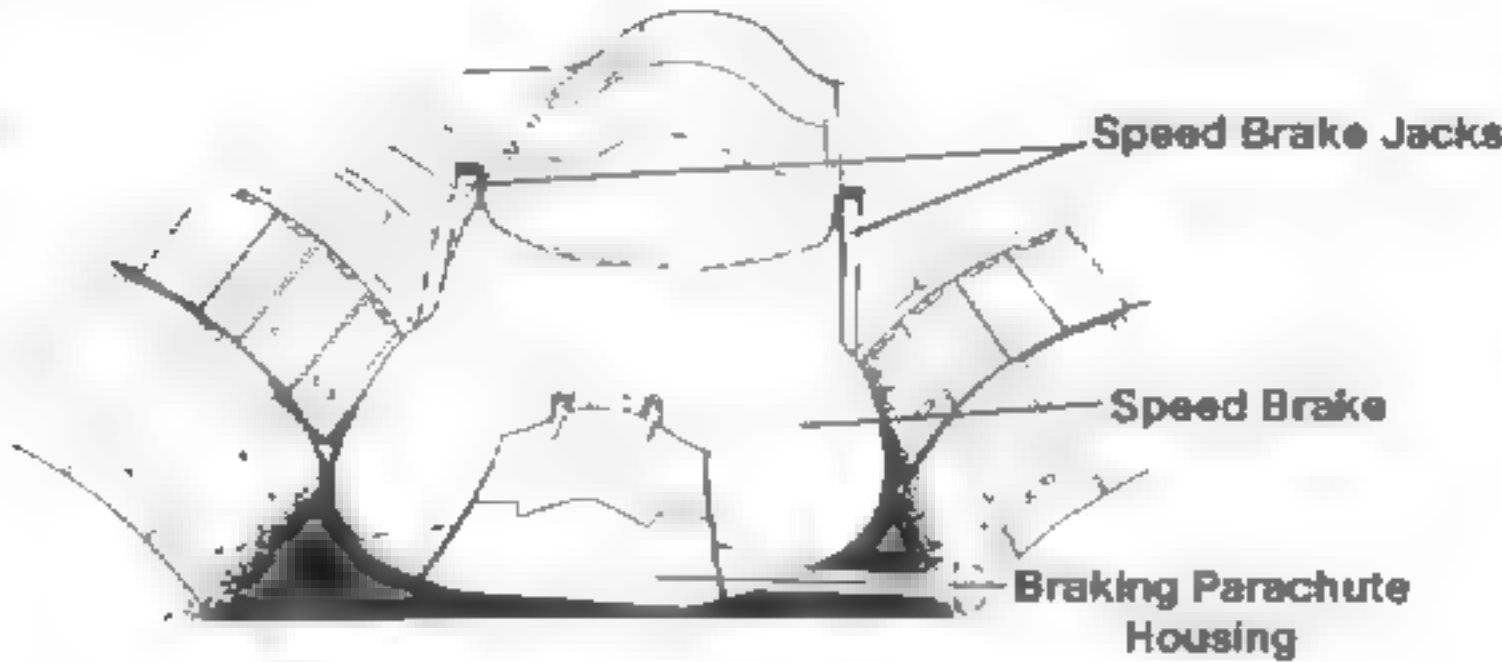




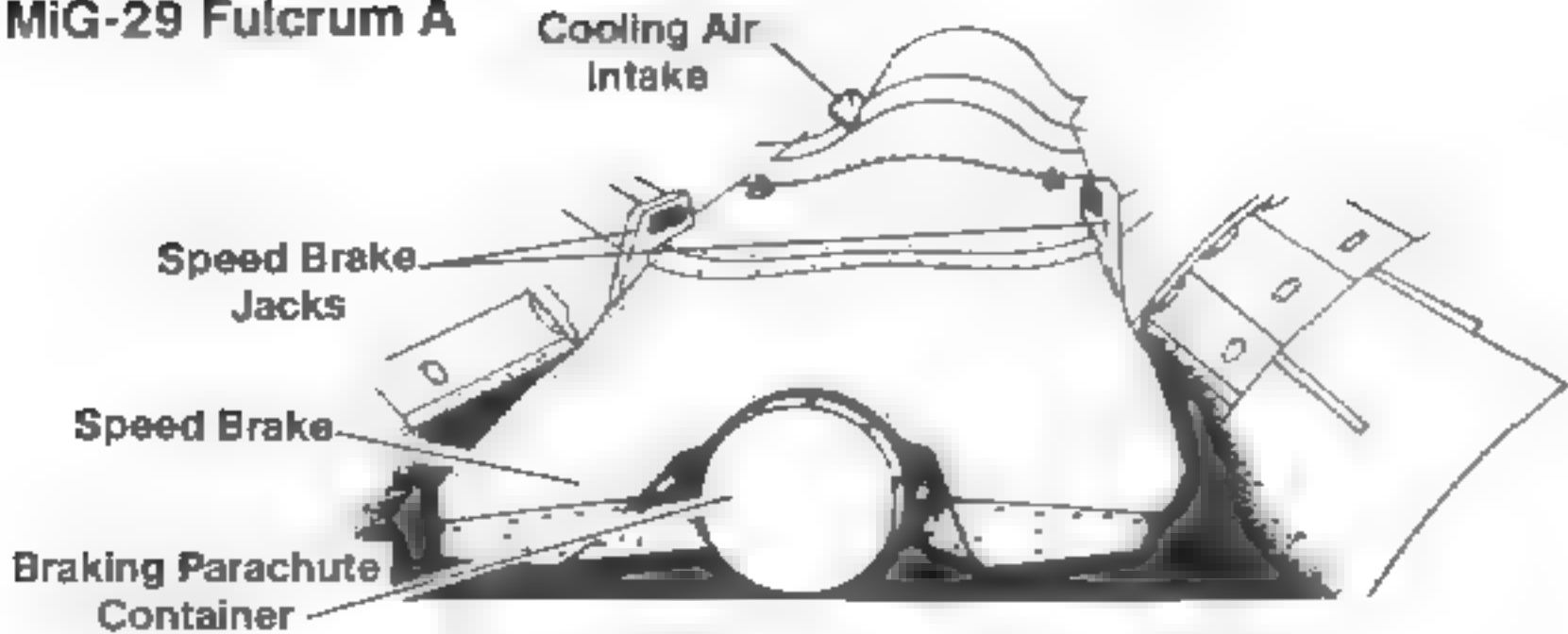
These early MiG-29s of the Ramenskoye based fighter unit carry non-standard Blue tactical numbers on the vertical fin. Normally, if the tactical number was repeated on the fin, it was in White on the fin tip VHF antenna fairing.

Speed Brake/Braking Parachute Development

**MiG-29
(Prototype)**

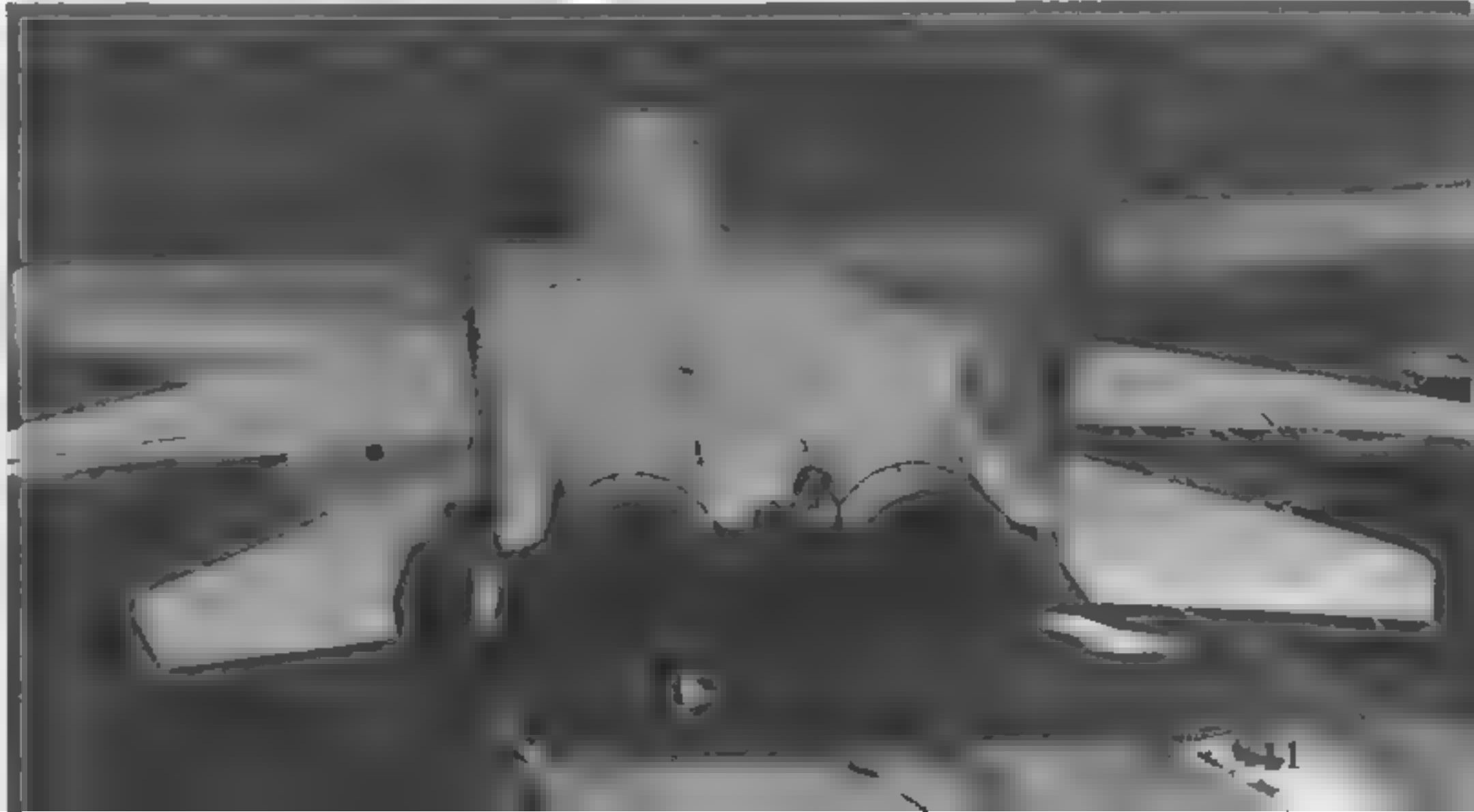


MiG-29 Fulcrum A



Blue 45, an early production MiG-29, undergoes a preflight inspection at Kubinka Air Force base. The R-73 air-to-air missiles are covered with tarps and the aircraft is fitted with small rear view mirrors on the side canopy railing (these mirrors were the same as on the MiG-23). (Zdenek Hurt)

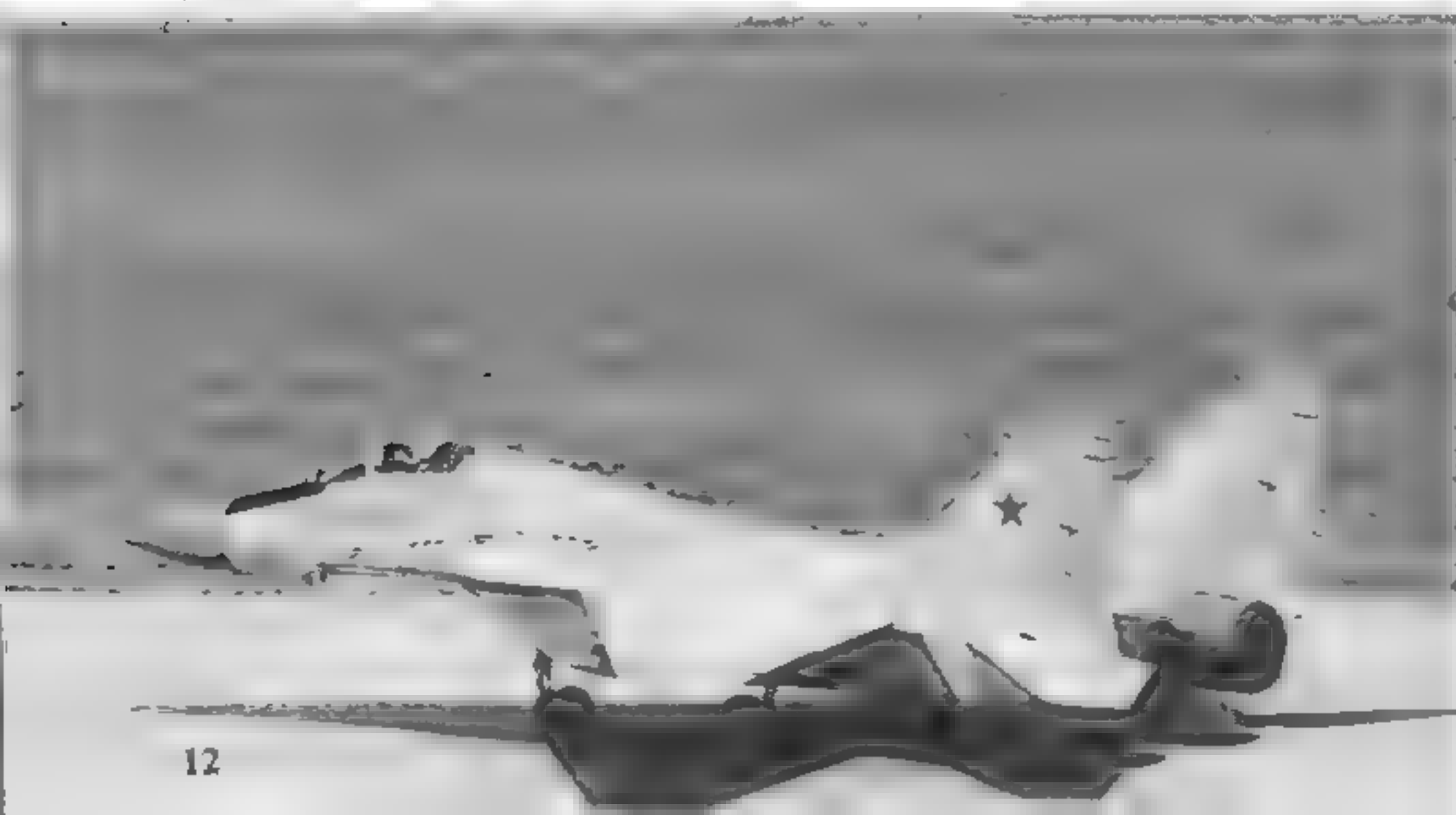
A ground crewman secures the cover on the braking parachute container on this early MiG-29 Fulcrum A parked on its hardstand at Kubinka Air Base. The aircraft is armed with four AA-8 Aphid air-to-air missiles. (Steven Zaloga)





Blue 49 was one of the early production MiG-29s that went to Finland during 1989. The aircraft has the ventral fins and undernose ILS antenna of the early production blocks, but also has some features of later production aircraft such as the blade style IFF antenna under the nose. (Klaus Niska)

Blue 47, an early production aircraft, during a visit to Kuopio-Rissala Air Force Base in Finland in the Summer of 1989. This aircraft appears to have been retrofitted with a Vortex generator on the nose, enlarged rudders and a blade style IFF antenna on the lower fuselage. (Hannu Vaitonen)



An early production MiG-29 Fulcrum A, Blue 42, chocked on its hardstand at Kubinka Air Force Base. This aircraft also features items from several production blocks such as the ILS antenna on underside of the nose (early) and vortex generator on the pitot tube (later). The aircraft is armed with R-60M (AA-8 Aphid) missiles on the wing stations. (Steven J. Zaloga)

MiG-29 Fulcrum A (Modified)

As with most modern combat aircraft, the MiG-29 underwent a number of modifications. As these modifications were tested and approved, they were incorporated into the production line. Even as the first production blocks of MiG-29s were being produced and fielded, the MIG-OKB was working on an improved variant of the Fulcrum. The improvements were based on the lessons learned by the Soviet Air Force during combat over Afghanistan.

Although the MiG-29 was never deployed to Afghanistan for a combat evaluation as did a number of Sukhoi Su-25 prototypes/pre-production aircraft, the war had a direct influence on future modification to the basic MiG-29.

One of the most most obvious external changes was the installation of extensions on the leading edge of the vertical fin that housed ASO-2W chaff/flare dispensers. Additionally, based on combat experience, improved SPO-15 electronic counter measures/warning instruments were installed to warn the pilot of incoming enemy missiles. At this same time, the ventral fin was deleted.

The flight tests of these modifications were carried out with a modified preproduction MiG-29 that had been retained by the MIG-OKB for flight testing of new modifications/improvements. After successfully completing the factory test program, the aircraft was turned to the LII-GA for evaluation of the chaff/flare dispenser fin extensions. After these tests were completed, the MiG-29 (Modified) was passed to the *NIIVSRKKA* for military and operational trials.

The improvements were accepted and the modifications were introduced into the MiG-29 production line.

MiG-29 Fulcrum A (Improved)

On Tuesday, 1 July 1986, a formation of four MiG-29s touched down on an air base outside the WARSAW Pact/Soviet Union. Led by COL V.V. Longineko flying Blue 01, the four aircraft from Kubinka Air Force Base made a four day courtesy visit to the Finnish MiG-21bis unit, the 31st Fighter Squadron at Kuopio-Rissala air base. The pilots were specially selected and briefed for this trip and only included high ranking officers (LTCOL V. Iachin in Blue 02, MAJs V. Solovjev in Blue 03, and V. Kravets in Blue 07 and A. Arastov in Blue 08).

The Fulcrums that arrived in Finland were from a recent production block and although they retained the undernose ILS antenna (typical of early production variants) all were equipped with the chaff/flare dispenser fin extension and blade style IFF antennas in place of the earlier Odd Rods IFF carried under the nose.

The arrival of the four Fulcrums in Finland, where they could be viewed by the Western press, created a lot of speculation about the aircraft and its performance. Actually the visit to Finland of the MiG-29s left far more questions than it answered. Of particular interest to Western intelligence personnel was the fact that all the aircraft from the



This preproduction MiG-29, Blue 10, served as the prototype for the Improved Fulcrum and was used by the LII-GA (Experimental Flight Institute of Civil Aviation). Besides the chaff/flare dispenser fairings, the aircraft was also equipped with a small electronics blister just behind the inboard louver.

Chaff/Flare Dispensers

MiG-29 (Early)



MiG-29 (Improved)



Kubinka Detachment lacked weapons pylons, giving them no clue to the weapons capability of the MiG-29.

Throughout its production life, the MiG-29 was continually changed and improved. With the addition of the chaff/flare dispensers, a small sensor blister was added to the fuselage just behind the upper air intake louvers. This blister covered a sensor used in connection with the radar warning receivers.

The blast suppression air duct/exhaust port behind the GSh-301 cannon port was changed. Early style ducts had a number of vertical ribs in the duct outlet port, while the new style duct had only two vertical ribs. The improved MiG-29 also had a vortex generator fairing alongside the pitot tube and extending back along the radome.

Early production MiG-29s had two small rear view mirrors on the side canopy framing. These mirrors were the same as those used on the MiG-23 Flogger series, the improved Fulcrum A was fitted with much larger side rearview mirrors on the side canopy framing, giving the pilot an improved view behind the aircraft.

During this period, the rudders on the MiG-29 were modified and increased in chord. These wide chord rudders greatly improved lateral control. The installation of the large chord rudders made it necessary to relocate the static dischargers on the vertical fin. On early MiG-29s these were mounted on top of the rudder, but on the improved MiG-29 the static dischargers are mounted lower (approximately nine inches).

The Odd Rods IFF antenna carried on the lower nose was replaced on the improved MiG-29 with a blade style IFF antenna. Improved MiG-29s also have dark colored dielectric panels on the leading edges of both the horizontal and vertical stabilizers.

These changes and improvements were not all introduced at the same time, and as a result, there are a number of aircraft in active service having a variety of different production block standards. Although all MiG-29s fitted with the Chaff/Flare extensions also have the ventral fin deleted as these two features were apparently introduced during the same production block.

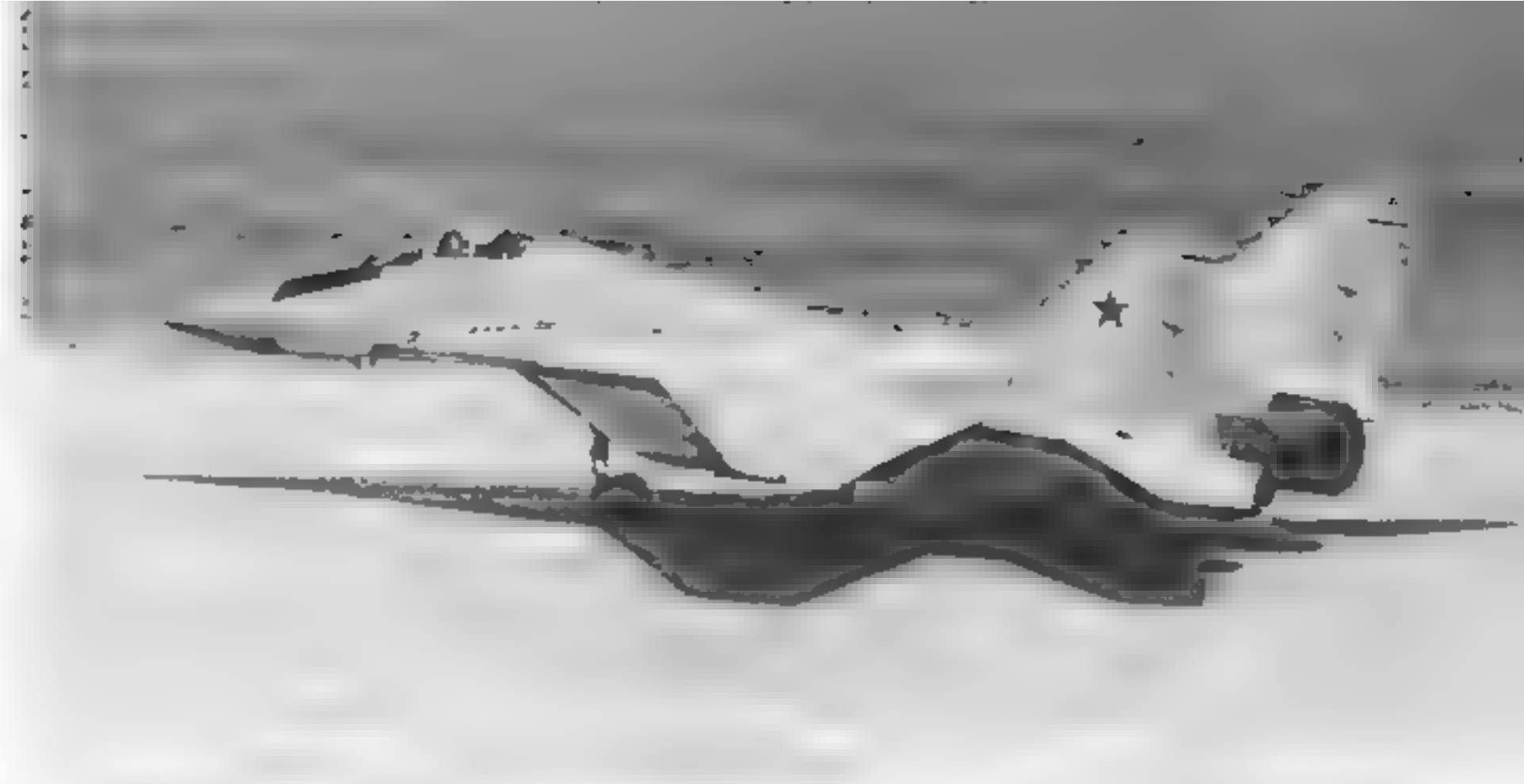
Up to 1990, some 800 MiG-29s had been built, with the majority being delivered to Frontal Aviation Regiments, although there are at least fifty aircraft known to be assigned to the Air Defense Forces (PVO) and 250 aircraft have been exported.

The Soviet Air Force approaches aircraft service life and factory upgrades differently than Western air forces. Periodically, fighters are pulled away from the flight line and sent back to the factory for upgrading and reconditioning back to zero-hours on the airframe. With the MiG-29 it is believed that a number of Fulcrum As will be upgraded to Fulcrum C standards when they come up for overhaul. The MiG-29's structure enables it to absorb electronics upgrades relatively fast. Replacement of existing electronic systems, as well as the attachment of additional external pods/fairings, is viewed as a fairly simple process.

Although the RD-33 power plant initially gave the designers a great deal of problems, the engine has evolved into a very reliable power plant. The power plant has very low fuel consumption, comparable to most advanced Western engines.

The MiG-29 requires 720 feet for its take off run and 1,800 feet for the landing run. The MiG-29 is unique in that a fully armed Fulcrum can takeoff on one engine, with the other engine being started in the air. This procedure can save precious seconds in the case of an emergency scramble.

The MiG-29's short legged main undercarriage, unlike earlier MiG fighters, limits operations to hard surface runways. This simple landing gear arrangement was selected mainly to save weight. Typical of all the MiG-OKB aircraft, the Fulcrum is easily maintained by ground personnel. Five mechanics can perform an engine change, changing



Blue 04 was an early production block improved MiG-29 with the chaff/flare dispenser fairing. It retained the ILS antenna under the radome, which was deleted on most improved MiG-29s, and still has the early blast suppression air duct/exhaust. Early production blocks of improved MiG-29s retained a number of components from earlier variants. (Hannu Valtonen)

and testing the RD-33 power plant in about an hour. The aircraft has a large number of access panels which simplifies maintenance. The engine's main drawback is its low TBO (Time Between Overhauls) of 350 hours.

The MiG-29 can carry a large variety weapons. For its primary role of air-to-air combat, the usual configuration consists of two R-27s (AA-10 Alamo), R-73s (AA-11 Archer) and R-60s (AA-8 Aphid), three missiles under each. The MiG-29 can also carry the older R-23 (AA-7 Apex) missile. Because of its weight (400 pounds), the R-27 is only carried on the inboard pylon.

For its secondary mission of ground attack, the Fulcrum can carry UB-32-57 rocket pods, each with thirty-two type S-5 57MM rockets or B-8M1 rocket pods with the larger S-8 (S-8K) unguided rockets. For ferry flights, the Fulcrum can carry an external fuel tank mounted between the engine nacelles. It is believed that this tank is not jettisonable.

One of the most impressive innovations used with the MiG-29 is the helmet mounted sight. This SUV Gunsight (*Sistiema Upravleniya Vooruzheniyem* or Armament Control System) is on a rail attached to the pilot's helmet. As the pilot turns his head to visually follow the target, this motion is transmitted to the weapons system, pointing the missile seeker head in the direction of the target. The SUV system can also be used to control and direct the entire aircraft. Set in the pilot-mode, the SUV directs the aircraft to follow the motion of the pilot's eyes. If the pilot looks left and down, the aircraft turns left and down.

Another warning system installed in the aircraft is known as the "Natasha Device," an acoustical warning system that provides the pilot information on possible threats or other dangers. Since the system uses a computerized female voice, the system quickly became known as *Natasha*. Some of the information presented to the pilot is obtained by the radar warning receivers, or other sensors, and recorded warnings such as "Enemy aircraft at six o'clock position" would be transmitted through the pilot's headset. Flight safety recordings are also available, keyed to inputs to the flight control system, such as "you are too low/slow on approach."

A passive radar warning sensor system (NATO reporting name Syrena 3) is fitted to the MiG-29. System receivers are mounted at various points on the fuselage giving the Fulcrum 360 degree coverage. The Syrena 3 provides input to the central computer

wind direction of the signals are hostile and assigns a priority. Threat information is passed to the pilot via *Svetlo* and simultaneously displayed on the instrument panel display. The *Svetlo* also informs the pilot if a missile has been launched against him and activates the aircraft's defenses such as the chaff/flare dispenser.

The MiG-29 also has a computerized self-test system to ease maintenance called the EKRAN device. The EKRAN system performs various automatic checks of the engine aircraft system, transmitting its readout as textual information to a remote recording device usually mounted on one of the maintenance trucks. The operator then is shuttled at a Repair and Maintenance Unit.

EKRAN also provides exact information on every flight and records the more important data such as G forces, speed, and other data important to predict the performance of the aircraft. Using EKRAN, maintenance specialists can quickly recognize if a structure should be checked for stress or if the engine malfunctioned.

The EKRAN system also provides the navigation and weapons station computers with mission related information and data. The information is fed into the remote sensor in the maintenance truck and then fed into the aircraft's systems via a plug in the MiG-29's wing root.

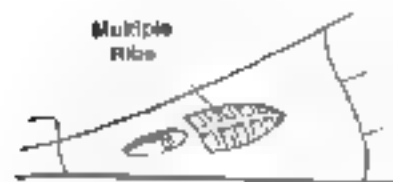
Most MiG-29s are based on Soviet territory, although there are a few based outside of the Soviet Union. Until recently there were a number of MiG-29s deployed with the Group of Soviet Forces in Germany (GSF) based at Wittstock-Dörsch and Merseburg. Two other MiG-29 Regiments were sent to Hungary occupying bases at Budapest-Lodol and Kiskút (later a Bvato-989) the Soviet regiment based at Kiskút which had been withdrawn mostly there is a MiG-29 squadron based at a former Air Base near Szécsény in Poland.

Blast Suppression Duct/Exhaust

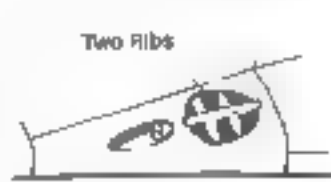


30mm Cannon Port

Position of Blast Suppression Duct/Exhaust



MiG-29 Fulcrum A
(Early)



MiG-29 Fulcrum A
(Improved)



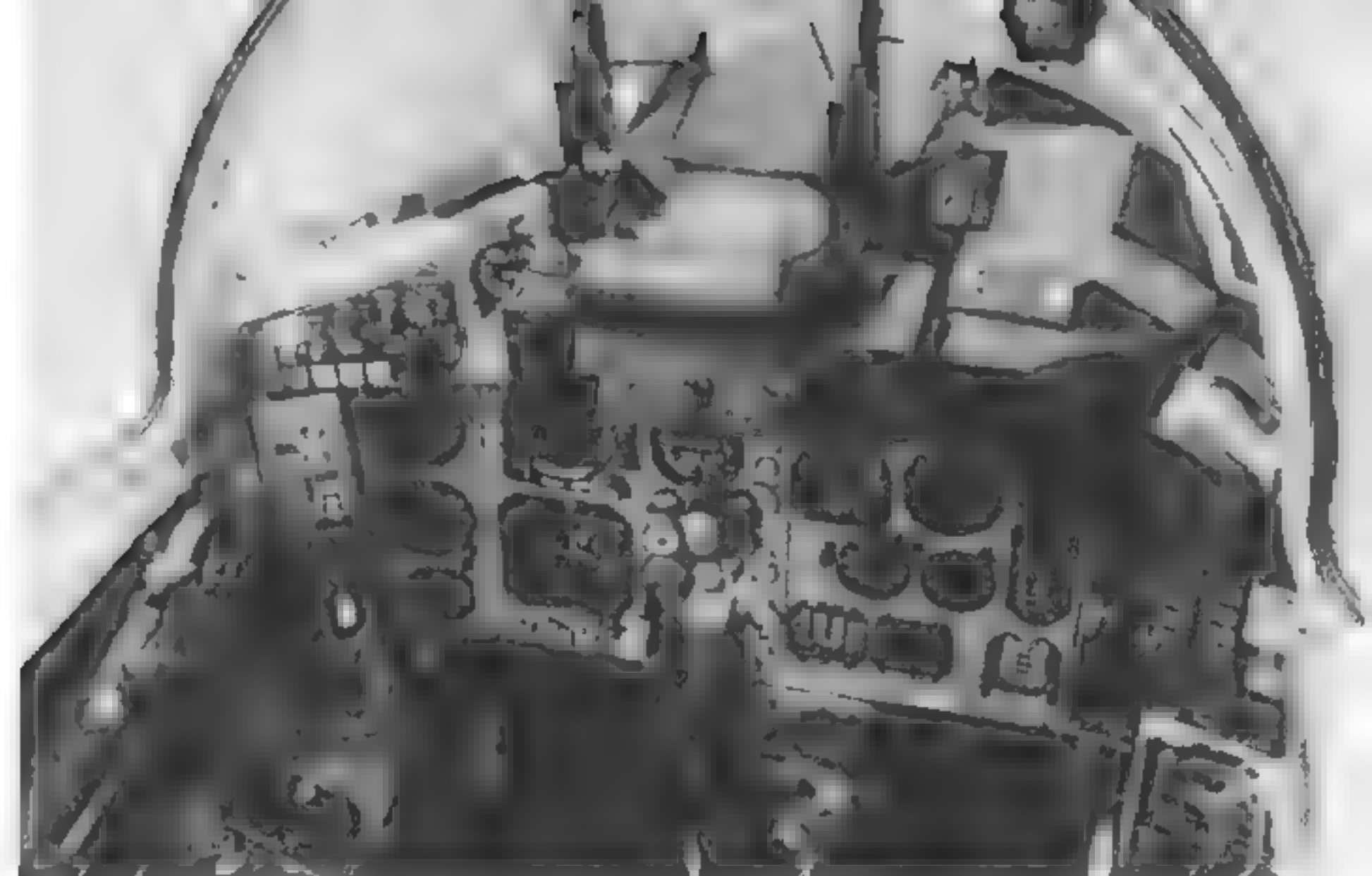
This early production block improved MiG-29 (Blue 27) was displayed at Tushino Air Base during August of 1989 equipped with a load of dummy missiles. The weapons configuration is standard for an intercept mission and consists of an R-27 (AA-10 Abasco inboard), an R-73 (AA-11 Archer center) and an R-60 (AA-8 Aphid outboard). (Peter Stache)

This MiG-29 (Blue 06) was flown by MAJ A. Arstev during the aircraft's visit to Kuopio-Rossia, Finland, on 1 July 1986. All the aircraft from this detachment had the early blast suppression air ducts and while some of the aircraft carried an ILS antenna under the nose others did not, such as this Fulcrum. (Klaus Niska)





This early production block improved MiG-29 was encountered by a Swedish Air Force reconnaissance aircraft over the Baltic Sea during 1986. The aircraft was equipped with an under fuselage fuel tank and was armed with two R-27 (AA-10 Alamo), two R-60 (AA-8 Aphid) and two R-73 (AA-11 Archer) air-to-air missiles. (Swedish Air Force)



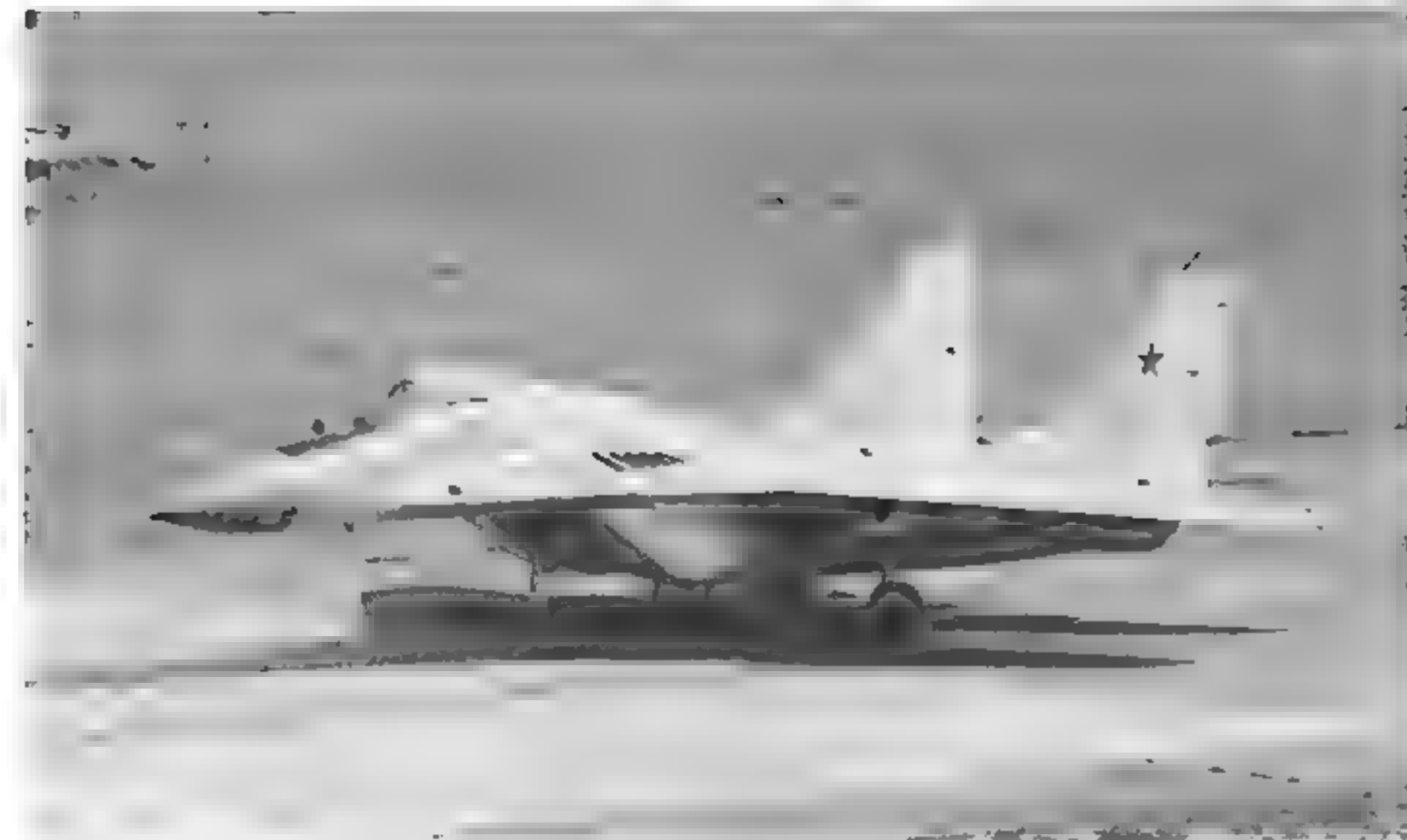
The cockpit layout of the MiG-29 is comparable to the F-4 Phantom and is fitted with the same type of instruments as the MiG-21bis and the MiG-23ML, making conversion training easier as well as simplifying production. Later MiG-29s had a different radar screen housing. (Dick Cole)

A pair of MiG-29s assigned to the Group of Soviet Forces in Germany parked on the ramp of their home base. Both aircraft have the later blade style IFF antennas but retain the early style blast suppression air duct/exhaust. MiG-29s were deployed to the GDR during January of 1986. (Wilfried Kopenhagen)



Ground crewmen prepare a MiG-29 Fulcrum A for display at the Farnborough Air Show in England. After the protective covers were removed, the MiG-29s were towed to the other side of the field. The aircraft demonstrated in Western countries are MiG-OKB factory aircraft and lack certain items of sensitive equipment. (Urs Hamisch)





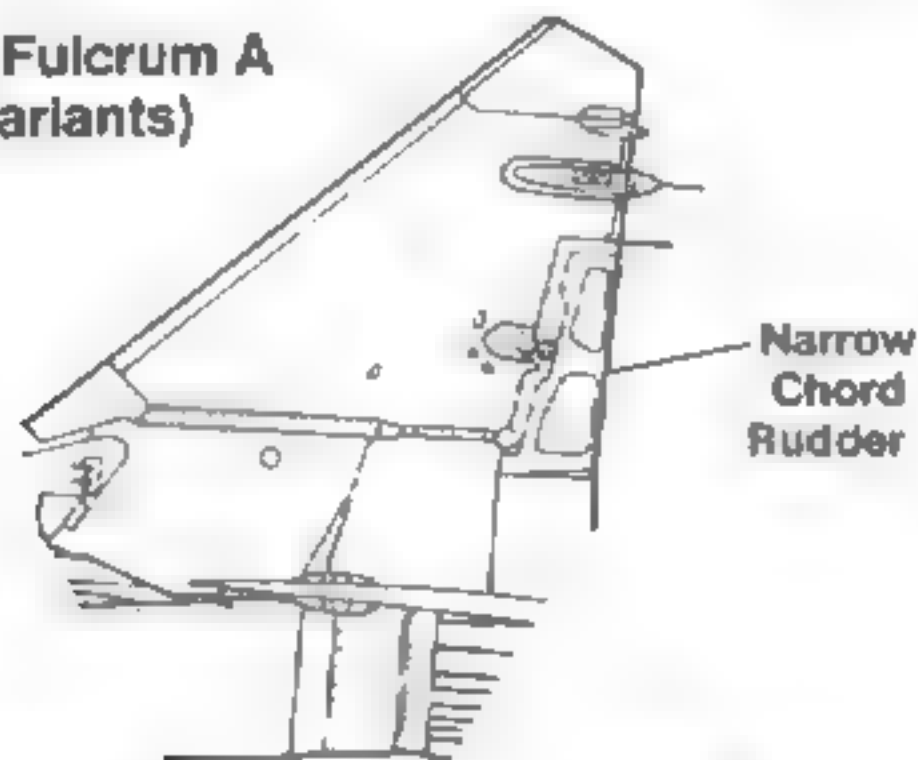
Blue 10 belonged to the Kubinka detachment which visited Finland during the Summer of 1989. Although it carries the same tactical number as the MiG-29 displayed at Farnborough, it is a different aircraft and carries a different camouflage pattern. (Hannu Valtonen)



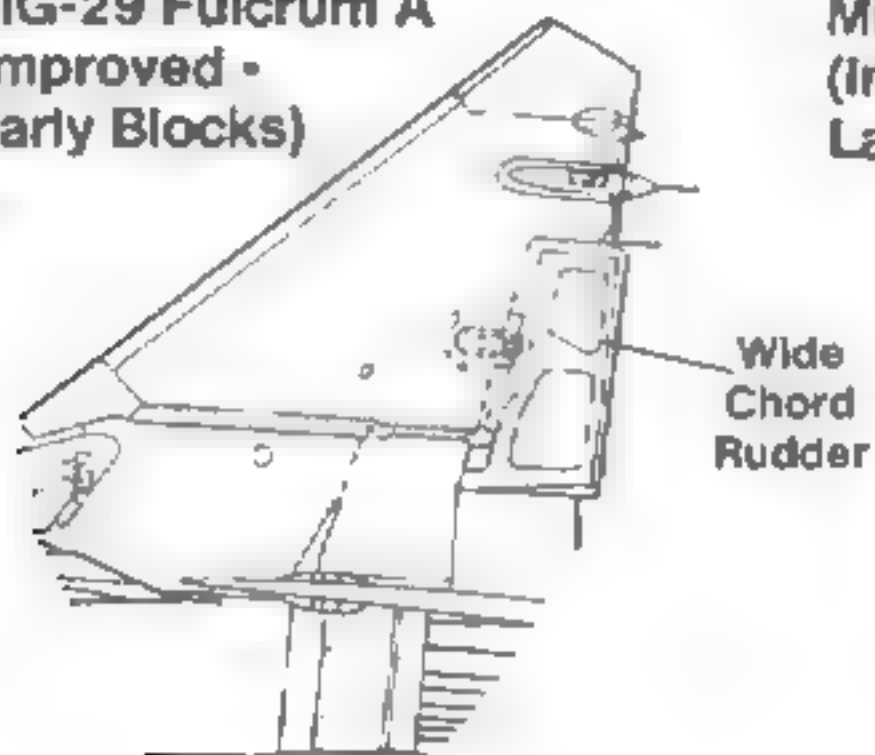
Blue 45, a MiG-29 Fulcrum A on the ramp at Kubinka Air Base, has the tactical number repeated on the fin tip in white. The aircraft has the wide chord rudders, introduced on late MiG-29 Fulcrum As, to improve lateral control.

Rudder Development

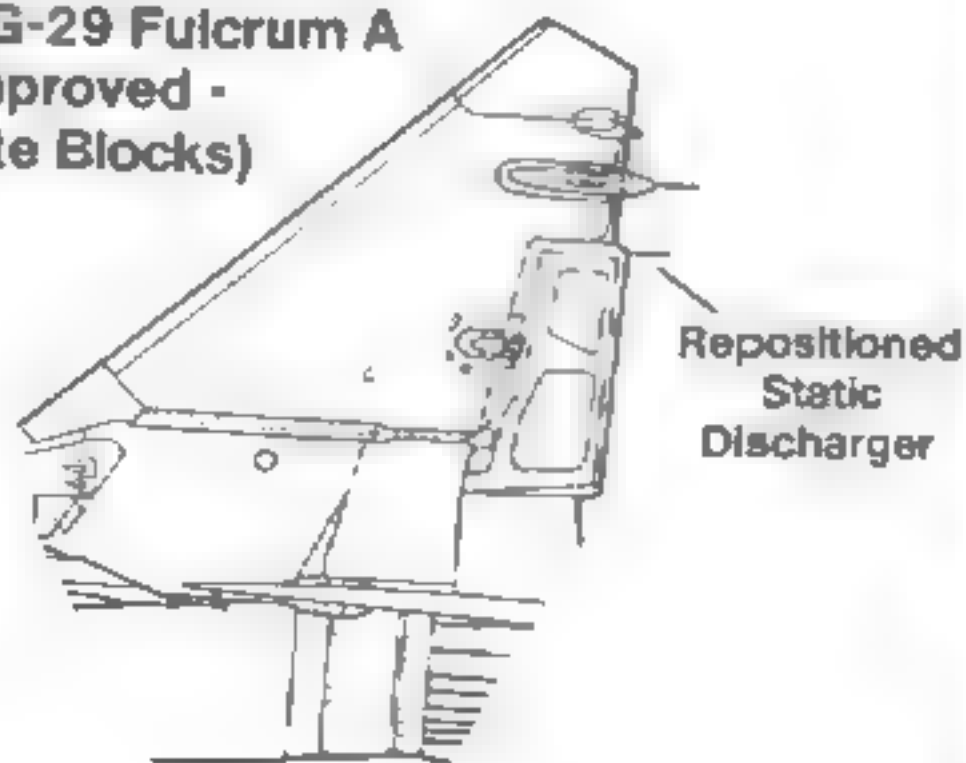
**MiG-29 Fulcrum A
(Early Variants)**



**MiG-29 Fulcrum A
(Improved -
Early Blocks)**

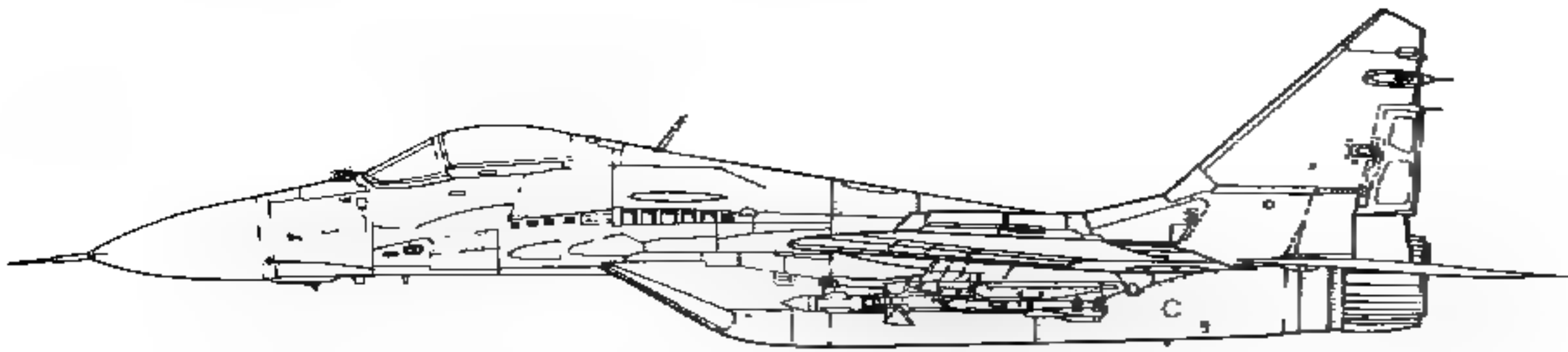


**MiG-29 Fulcrum A
(Improved -
Late Blocks)**



This improved MiG-29 Fulcrum A, Blue 51, on the ramp at Rissala Air Force Base during the Summer of 1989 is a late production block aircraft with the wide chord rudder and vortex generator on the pitot tube. The aircraft in the background is an early production MiG-29 with the ventral fin. (Klaus Niska)

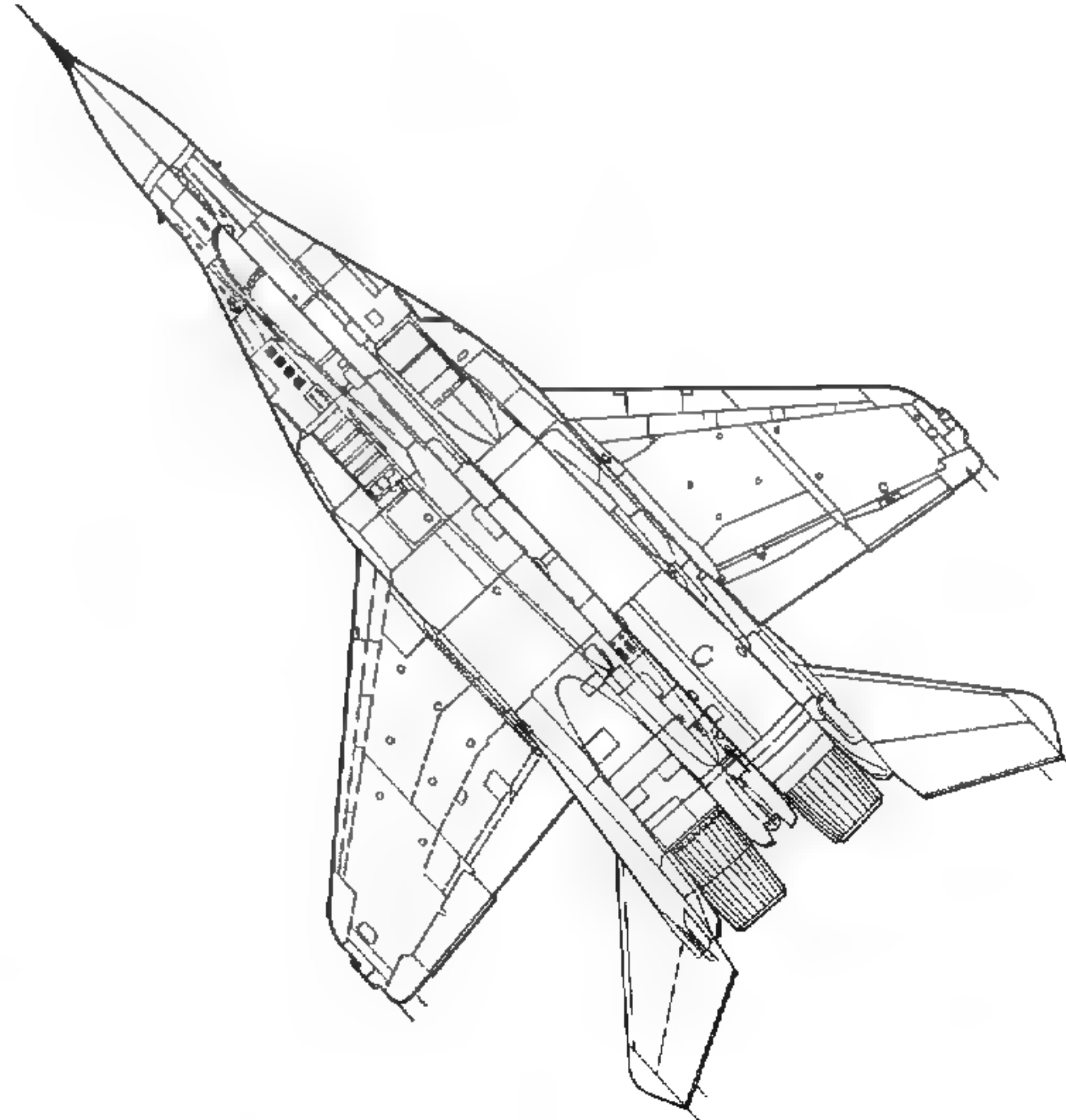




Specifications

MiG-29 Fulcrum A (Late)

Wingspan	37 feet 4 inches
Length	56 feet 10 inches
Height	15 feet 6 inches
Empty Weight	18,025 pounds
Maximum Weight	39,000 pounds
Powerplants	Two 18,300 lbf Izotov R-33D turbopan engines
Armament	One 30MM GSh-301 cannon Two R-60 (AA-8) Aphid Two R-73 (AA-11) Archer Two R-27 (AA-10) Alamo air-to-air missiles
Performance	
Maximum Speed	1,320 mph
Service ceiling	56,000 feet
Range	1,130 miles
Crew	One





A Canadian Armed Forces CF-18 Hornet of No 441 Squadron escorts the MIG-OKB's display MIG-29 Fulcrum A flown by Roman Taskayev over the rugged Canadian mountains enroute to Vancouver. The MiG-29 is equipped with external fuel tanks on the inboard wing pylons. (Canadian Forces Photographic Unit)



This MiG-29 Fulcrum A has a rail attached to the center wing pylon to allow it to carry a UB-32-57V rocket pod used in the ground attack role. For ground attack missions the MiG-29 can also carry a variety of other weapons including bombs and a variety of rocket pods.

This MiG-29 Fulcrum A on the ramp at Kubinka Air Base during June of 1990 carries a "Guards" emblem on the nose. This marking indicates that the unit can trace its history back to the Second World War during which it earned the title of Gwardijs Regiment.



MiG-29 Exports

The MiG-29 has been exported to a number of countries both within and outside the WARSAW Pact. During the 1950s and 1960s, normal Soviet policy was to sell new fighters first to members of the WARSAW Pact, then to other countries. This doctrine changed with the introduction of the MiG-23, with the first Flogger exports going to countries in the Middle East.

Moscow's change in policy was connected with the Soviet Union's desperate need for hard Western currency. Additionally, it was not unusual for foreign allies to be equipped with modern Soviet equipment ahead of WARSAW Pact allies when vital foreign policy interests were involved.

While aircraft sold to non-WARSAW Pact countries usually were delivered against hard currency, such as U.S. dollars, aircraft delivered to members of the WARSAW Pact are paid in "Transfer Rubles," a non-existent currency used to pay bills within WARSAW Pact members. "Transfer Rubles" include a portion of the payment in local currency, however, the exchange rate was set by Moscow. Additionally, at least a portion of the purchase price must be paid in hard currency. When the Soviet Union first offered the MiG-29 to WARSAW Pact members, they were quite startled by its high price when compared to the amounts they had paid for MiG-21s and MiG-23s.

Most MiG-29 purchase contracts also cover conversion training. This training is conducted at the Soviet Air Force Academy at Kiev. Along with pilots, foreign ground crew also receive instruction in MiG-29 maintenance. The course is mainly classroom in nature and is held in Russian (the Command language within the WARSAW Pact).

Compared with training given by Americans to foreign air and ground crews (including non-NATO countries) on new aircraft, Soviet training is somewhat crude and is limited to basic flight training on the aircraft. No combat/weapons training is conducted and students never fire the GSh-301 or air-to-air missiles.

Receiving nations normally send highly qualified instructor pilots to the USSR for conversion training, which usually lasts from nine months to one year. When they return, these instructor pilots will train others on the Fulcrum.

The export price quoted by the AVIAEXPORT during 1989 was \$23 million (US) for the single seat MiG-29 Fulcrum A and \$28 million for the two seat MiG-29UB Fulcrum B.

India

India was the first export customer for the MiG-29. During early February of 1984, the Indian Air Force was invited to evaluate the MiG-29 and offered a fly-away price of \$11 million (US). Soviet Defense Minister Dimitri F. Ustinov visited New Delhi in March of 1984 to discuss sales of advanced weapons to the Indian armed forces. These discussions led to a preliminary agreement for the supply of forty-four MiG-29s. Two Indian Air Force evaluation pilots departed for the USSR to test the aircraft — the first foreign pilots to fly a MiG-29. Conversion training took place at Lugovaya Air Base with ground personnel receiving their training at Frunze Air Base.

During December of 1986, the first twelve partly disassembled airframes arrived in India. These were reassembled by Hindustan Aeronautics Limited (HAL) in their plant at Nasik. After reassembly, the aircraft were tested by Soviet factory test pilots before being handed over to the Indian Air Force.

Since India's primary interest was to acquire fighters that would equal or outclass the F-16s being delivered to Pakistan, the original Soviet proposed avionics and weapons offered with the export MiG-29 proved unacceptable. Faced with the Indian government's

refusal to accept a less-than-state-of-the-art Fulcrum, the Soviets relented and granted export of standard MiG-29s, although the aircraft were delayed almost a year.

India ordered forty single seat MiG-29 Fulcrum As and four Fulcrum B trainers. The first aircraft were delivered during April and May of 1987 to No 47 Squadron, the Archers, based at Poona. This unit was followed by a second squadron, No 28 Squadron, the First Supersonics. Both units had previously flown the MiG-21. The MiG-29's formal introduction ceremony took place on 6 December 1987 at Poona Air Force Base, where the aircraft was given the name *Baaz* (Falcon).

All Indian Air Force MiG-29s carry standard Soviet air superiority Gray camouflage. Additionally, most of the aircraft have an Odd Rods IFF antenna below the nose instead of the newer blade-type IFF antenna. Instead of a Soviet style tactical number, Indian aircraft have a serial number consisting of a two letter type identification code and three digits carried in Black above the fin flash. Also beginning in early 1988, the Indian Air Force began to paint Squadron insignias on the air intakes of its MiG-29s.

Syria

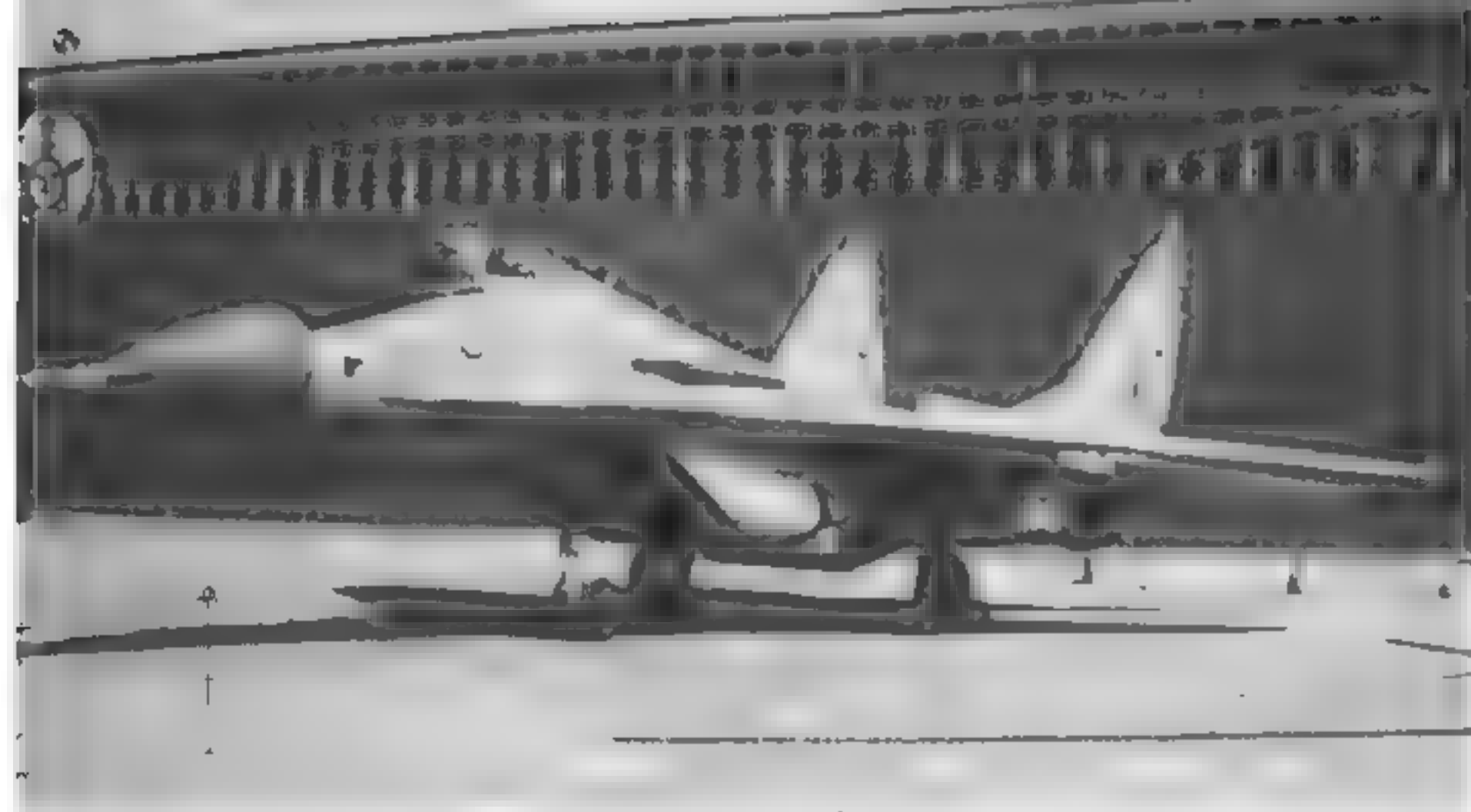
Syria became the first Middle Eastern customer for the MiG-29 as a result of President Hafez El Assad's visit in Moscow during 1986. His request for MiG-29s was repeated during the visit of his Minister of Defense, Mustaf Tlass, to Moscow during April of 1987. At this time Mustaf Tlass stated that the Syrian Air Force had a requirement for 150 Fulcrums.

During July of 1987, the first sixteen aircraft arrived in Syria. These were followed by a second batch of sixteen during the Fall of 1988. A short time later, the Soviet Union suspended additional deliveries of the MiG-29 to Syria.

The first Syrian Air Force MiG-29 squadron reached operational status during November of 1988 after a lengthy training cycle. Soviets reported that the length of the course was due to the fact that Syrian pilots seemed to have difficulty in mastering the MiG-29.

An Indian Air Force MiG-29 Fulcrum A of No 28 Squadron, First Supersonics, in flight over the Himalayas. This aircraft (KB729) was one of the first MiG-29 aircraft delivered to the Indian Air Force.





This MiG-29 Fulcrum A was assigned to the other Indian Air Force Fulcrum squadron, No 47 Squadron, The Archers. KB 716 was another of the first delivery batch. The aircraft was based at Poona Air Base near Bombay, during December of 1987.

There are unconfirmed reports (originating from Israeli sources) that a Syrian pilot defected to Israel during 1990 with a MiG-29 Fulcrum A. Additionally, there are also reports that an air-to-air engagement took place between Israeli fighters and Syrian MiG-29s during early 1991, with the Syrians losing at least one Fulcrum.

Iraq

During 1987, Iraq entered negotiations with the Soviets for forty-eight MiG-29s. The first group of eighteen were delivered during that same year, shortly after Syria received its first MiG-29s. Iraqi pilots received their conversion training in the USSR.

During 1989, another sixteen MiG-29 Fulcrum As and two MiG-29UB Fulcrum Bs were delivered to Iraq. It is believed that all Iraqi MiG-29s were based near Baghdad for air defense of the capital. Reportedly, the Iraqi Fulcrums were controlled and directed by a Il-76 AWACS aircraft that, unlike the Il-76 Mainstay, was developed and modified in Iraq with locally developed electronics under the name *Adnan I* (in memory of Adnan Khajrallah Talfan, the defense minister and Saddam Hussein's cousin who was killed in May of 1988). The Iraqi Il-76 AWACS reportedly operated from Saddam Hussein Airport in Baghdad.

Reportedly, the first batch of MiG-29s delivered to Iraq carried a desert camouflage. This scheme replaced the darker upper surface Gray color with a Tan color, while retaining the Light Gray base color. Later deliveries to Iraq all carried standard Soviet air superiority Gray camouflage with the national markings on the lower wing surfaces and on the base of the vertical fin, a fin flash was also carried higher on the vertical fin. The three digit tactical number is in the same location as Soviet MiG-29s, but it is written in Black Arabic style numbers. All maintenance and service instructions are in English and all stencils are in Red.

During the early phases of the Gulf War, the Iraqi Air Force lost at least eight MiG-29s in air-to-air combat with USAF F-15 Eagles and USN F/A-18 Hornet fighters. Additionally, a substantial number of MiG-29s were reportedly flown to Iran where they



An Iraqi Air Force MiG-29 Fulcrum A (Black 29060) on the apron at Baghdad International Airport during the Spring of 1990. The tactical number on the air intake is written in Black Arabic style numbers. During the early stages of Operation DESERT STORM, the IAF lost at least eight MiG-29s in air-to-air combat. (Christopher Foss)

were impounded. It is believed by American intelligence agencies that these aircraft were sent to Iran to save them from Allied air attacks and for use in rebuilding the post-war Iraqi Air Force. One incident during the early days of the war involved two MiG-29s on a low-level air patrol. According to Allied pilots, one MiG-29 accidentally shot down his wingman, then became disoriented and crashed into the desert.

This MiG-29 Fulcrum A was one of sixteen aircraft delivered to Iraq during 1989. Iraqi MiG-29s are unusual in that they carry the triangle national insignia on the base of the vertical fin along with a fin flash higher on the fin. No national insignia is carried above the wings. (Christopher Foss)



Yugoslavia

Yugoslavia was the first European export customer for the MiG-29. The Fulcrum was ordered during 1986 under the Yugoslavian designation L-18 (L for *Lovac* or Hunter)

During October of 1989, the first aircraft were flown from the MiG-OKB factory direct to Yugoslavia using a centerline external fuel tank carried between the engine bays. The initial delivery consisted of fourteen MiG-29 Fulcrum As and two Fulcrum Bs. These were followed by two, sixteen aircraft batches spread over a two-year period. The MiG-29s were used to form a new three Squadron Regiment within the Yugoslavian Air Force, supplementing rather than replacing the MiG-21 Fishbed in the Air Defense Fighter Regiments

The aircraft were shown to the public at Batajnica Air Force Base near Belgrade for the first time on 15 May 1988

With the introduction of the L-18 (MiG-29) a major problem was encountered. The underground tunnel-type shelters at principal Yugoslav air defense fighter bases had been built to accommodate the MiG-21. As a result, they were too small for the Fulcrum and new shelters had to be prepared for the MiG-29 force

The L-18s carry standard Soviet air superiority Gray camouflage. The last three digits of the aircraft serial number are repeated in White on the nose as well as on the starboard wing upper surface and port wing undersurface. National insignia are carried on the opposite wings. The fin flash is applied as a Red-White-Blue stripe on the vertical fin. Just above it, the aircraft serial number once more repeated, this time in Black.

Germany

The German Democratic Republic became the first WARSAW Pact member to be equipped with the MiG-29. During the 1984 visit of the Swedish Minister of Defense to Peenemünde Air Force Base, East Germany's Minister of Defense, Heinz Hoffmann, announced his intention to purchase the MiG-29 for the East German Air Force. This was the first indication in the West that East Germany planned to acquire modern aircraft.

The first German pilots selected for MiG-29 training departed for the Soviet Union during early 1987, and during late 1987 the first aircraft were delivered to Preschen, home base of *Jagdfliegergeschwader 3, Wladimir Komarow*. On 5 April 1988 the first of two *Staffel* (Squadron) was declared fully operational.

Integration of the MiG-29 into the *Luftstreitkräfte* was slow because of the need to upgrade East German airfields with new navigational and landing aids that were required for MiG-29 operations.

The German MiG-29 Fulcrum As and one of the four MiG-29UB Fulcrum Bs in service all carry a different camouflage than their Soviet counterparts. These aircraft are painted in what is known as the Central European Camouflage Scheme. This is a tactical camouflage used on Czech and German Fulcrum, which consists of an upper surface camouflage of two Green shades and two Brown shades, over Gull Gray undersurfaces.

German Fulcrum A carried a Red three digit tactical number, while the Fulcrum Bs had a three-digit Black tactical number. In the East German Air Force, Red tactical numbers denote Combat aircraft, while Black denote trainer aircraft.

East German MiG-29s differ from all other export MiG-29s in that they carry locally produced electronics. The East Germans replaced some of the Soviet produced electronics with components developed and produced in the German Democratic Republic by the *Militärtechnisches Institut* (Military Technical Institute) at Wuhlheide near Dresden. It is known that some parts of the Doppler radar were replaced as well as the entire IFF system.



This Iraqi Air Force MiG-29 Fulcrum A (Black 29060) was displayed at Saddam Hussein Air Field outside Baghdad during early 1990. The MiG-29 was the most advanced fighter available to the IAF at the beginning of the Gulf War and reportedly, a large number were flown to Iran for safe keeping. (Christopher Foss via Steven Zaloga)

On 3 October 1990, the German Democratic Republic ceased to be, and the two Germanys were reunited. As a result, the MiG-29s belonging to the former East German Air Force were absorbed into the *Bundesluftwaffe*. The MiG-29s were the only combat aircraft taken over, the only others types being a few transports, helicopters and trainers.

Four MiG-29s were assigned to the test and evaluation center of the *Bundesluftwaffe* (WTD-61) at Manching Air Base. These aircraft were repainted in West German markings and codes. There were two MiG-29 Fulcrum As (29+20 and 29+21) and two MiG-29UB Fulcrum Bs (29+22 and 29+25). During the evaluation, it was decided that the entire complement of JFG-3 would be put into active service with the new German armed forces. The MiG-29 Fulcrum As in German service are coded 29+01 through 29+21 (29+13 was not assigned) and the Fulcrum Bs are coded 29+22 through 29+25.

Three Yugoslav Air Force MiG-29 Fulcrum As on the ramp at Batajnica Air Base. The first batch of sixteen aircraft were delivered during October of 1989. Introduction of the MiG-29 into YAF service made it necessary to enlarge the underground (designed for MiG-21s) shelters on YAF bases. (Milan Micevski)





A pair of Yugoslav Air Force MiG-29 Fulcrum As on patrol armed with AA-10 Amos long range missiles on the inboard pylons, AA-11 Archer medium range missiles on the center pylons and AA-8 Aphid dogfight missiles on the outboard pylons. This mix of missiles is the standard air intercept configuration for the MiG-29. (Milan Micevski)

Czechoslovakia

The first MiG-29s for the *Ceskoslovenske Letectvo* arrived during the Spring of 1989 and were based at Zatec as part of 11 *Stíhací Letecký Pluk Invazní* (No 11 Fighter Interceptor Regiment), 3rd Air Defense Division. The Fulcrums equipped two squadrons within the Regiment, with the remaining squadron retaining its MiG-21PFMs and MiG-21MFs.

In September of 1989, the Fulcrum became fully operational and, like the former East German Air Force Fulcrums, Czech Air Force MiG-29s carry the Central European Camouflage with a four-digit Black tactical number with a thin White outline being carried on the vertical fin.

Initially, it was planned to equip a number of the Fighter Interceptor Regiments with at least one squadron of MiG-29s. In January of 1990, however, the Czech Defense Minister, Miroslav Vacek stated that his government had abandoned further purchases of the MiG-29. It is believed that there are some twelve to sixteen MiG-29s currently in Czech service.

Poland

The *Polskie Wojska Lotnicze* was the third WARSAW Pact country to be equipped with the MiG-29. During 1988 the first contingent of Polish pilots departed for the USSR to begin conversion training. In the Spring of 1989, the first seven Fulcrum A fighters and four Fulcrum B trainers arrived at Minsk Mazowiecki Air Base. These Fulcrums were used to equip the first Squadron of 1 PLM (*Pulk Lotnictwa Myśliwskiego*, 1 Fighter Regiment), the most popular unit in the Polish fighter force.



A ground crewman prepares to direct the pilot of White 101 out of its parking spot, while a second crewman prepares to disconnect the external power cables. This aircraft was the first MiG-29 Fulcrum A supplied to the Yugoslav Air Force. (Milan Micevski)

This unit was the first to receive new fighters when they were introduced into Polish service. 1 PLM became the first Polish fighter unit to be equipped with jets (Yak-23s), the first to receive the MiG-15 Fagot in July of 1951 and the first to re-equip with the MiG-21 Fishbed (1963). This tradition continued with the MiG-29. Although the fighters changed, the unit's mission has remained unchanged — the air defense of Warsaw.

These MiG-29s carry the unit insignia, the crest of the city of Warsaw, known as the *Syrenka*, on the nose. The color of the girl denotes the aircraft's squadron with Yellow for the first squadron, Red for the second and Blue for the third. These aircraft carry the standard air superiority Gray camouflage with Red, two-digit tactical numbers on the air intakes. In sharp contrast to the Soviets and other WARSAW Pact users, Polish MiG-29s carry no upper wing national insignia.

Due to rising costs, the future of the MiG-29 in Polish service is clouded. It is unlikely that further aircraft will be purchased to complete the re-equipment program and there are plans to replace the MiG-29 with either the F-16 or French Mirage 2000.

While the MiG-29 is mostly used for the air-to-air role, the aircraft can carry air-to-ground weapons such as the UB-32-57V rocket pods carried on the center wing pylons of White 105. The UB-32-57V pod carries thirty-two 57mm unguided air-to-ground rockets.

(Milan Micevski)



Romania

The first rumors that the *Forțele Aeriene ale Republicii Socialiste România* (Romanian Air Force) would be receiving the MiG-29 to replace its MiG-21s surfaced during 1989 and the first Romanian pilots departed during the Spring of that year for the Air Academy at Kiev to begin MiG-29 conversion training.

The first MiG-29s for the Romanian Air Force were ferried to Romania by these pilots. For the delivery flight, the aircraft carried no national markings. The national markings, as well as the tactical numbers, were applied after the fighters arrived in Romania. The first MiG-29s arrived during November of 1989 at Kogălniceanu Airport near Constanta on the Black Sea. They were assigned to one *Escadrila* (Squadron) of the Fighter Interceptor Regiment, while the remaining two squadrons retained their MiG-23MF Flogger Bs.

The last of the initial twelve Fulcrum As and two Fulcrum Bs arrived during December of 1989, only a few days before the revolution. Since the group was not fully operational and was still involved in training missions, they did not take part in the fighting between regular Romanian Army units and the *Securitate*.

All the Romanian Fulcrums carry the standard Soviet air superiority Gray camouflage and carry the roundel type national markings in the same locations as on Soviet aircraft. Romanian MiG-29s carry a two digit Red tactical number on the air intake.

It was planned to demonstrate a formation of three MiG-29s during an air show at the București-Băneasa airfield. During the preparations for this air show, two MiG-29s were involved in a mid-air collision which killed both pilots and a ground crewman.

North Korea

North Korea was the first export customer for the MiG-29 in Asia. During May and June of 1988 the first twelve of twenty-five Fulcrums were delivered to equip a single air defense squadron. This unit keeps some twenty aircraft in service and holds five back as an attrition reserve.

Two MiG-29s of the East German Air Force high over their homeland. Since Preschen is located close to the Polish border, Poland allows the East German pilots to turn into their airspace on the final approach and the landing; in turn, the Polish are allowed to do the same on their Polish bases in Silesia, close to the East German border. (Matthias Grunder)

Cuba

The *Fuerza Aera Revolucionaria de Cuba* received its first MiG-29s during October of 1989. These aircraft were part of a military aid package, agreed to during 1986, which called for delivery of twelve Fulcrum As and two Fulcrum Bs.

The first two aircraft arrived in crates aboard a freighter during October of 1989. After off-loading, the crates were taken to San Antonio des Los Baños airfield for reassembly. The first aircraft was successfully test flown on 19 April 1990, and it is believed that the unit is now operational.

Iran

During the Autumn of 1990, Iran took delivery of fourteen MiG-29 Fulcrum As. These were delivered after Iranian President Hashemi Rafsanjani visited Moscow requesting military aid to help rebuild the Islamic Republic of Iran Air Force (IRRAF) after the eight year Iran-Iraq war.

Reportedly the Iranian Fulcrums, which were declared operational on 7 October 1990, carry a desert camouflage. This camouflage replaces the Dark Gray of the air superiority scheme with a Tan color while retaining the Light Gray base color.

Bulgaria

During early 1990, Bulgaria took delivery of twelve MiG-29s becoming the last Warsaw Pact country to receive the MiG-29. The Fulcrums were used to re-equip one squadron of an air defense regiment (with the remaining two squadrons retaining their MiG-21s).

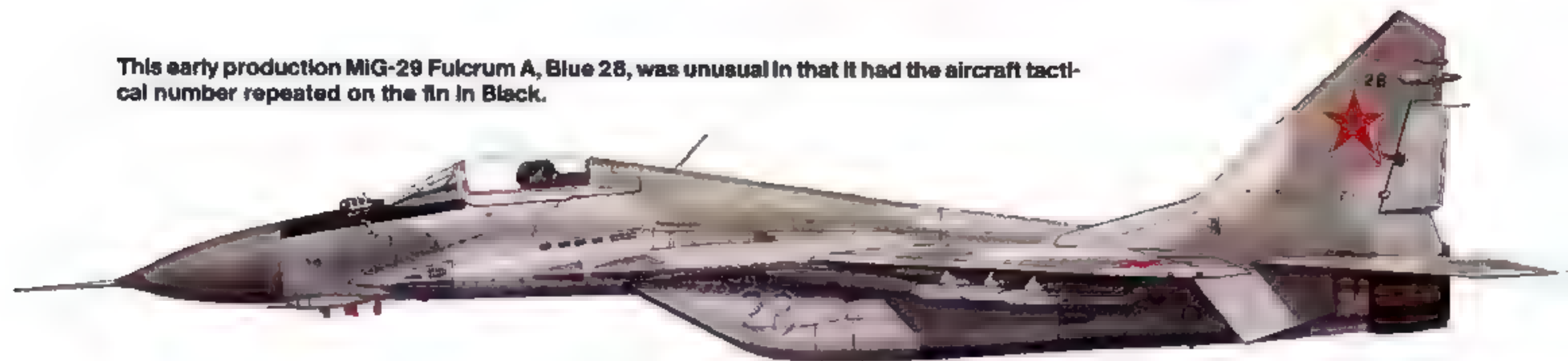
Bulgarian MiG-29s carry standard Soviet air superiority Gray camouflage with Bulgarian national insignia on the vertical stabilizer and both upper and lower wing surfaces and two-digit tactical numbers in White on the air intakes.



The MiG-29 prototype, Blue 01, flew for the first time during 1977. The aircraft is now on display at the Soviet Air Force Museum at Monino, near Moscow.



This early production MiG-29 Fulcrum A, Blue 28, was unusual in that it had the aircraft tactical number repeated on the fin in Black.



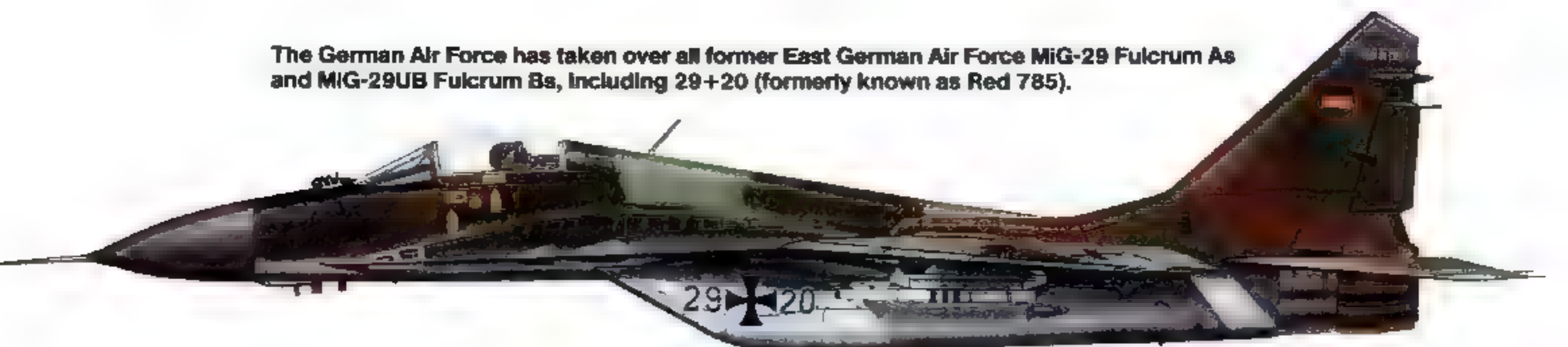
India was the first export customer for the MiG-29. This Indian Air Force MiG-29 was assigned to No 47 Squadron, known as the Archers.



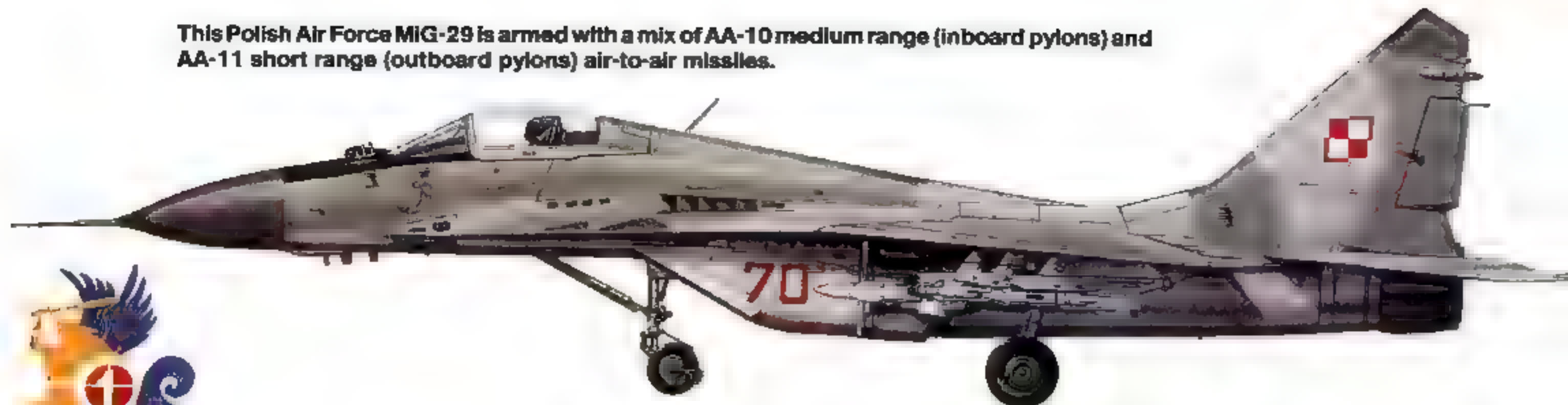
During the first week of the Gulf War, the Iraqi Air Force reportedly lost some eight MiG-29s. It was a combination of superior training and tactics that allowed Allied fighters to control the sky over Iraq. The Arabic serial on the intake reads 29070.



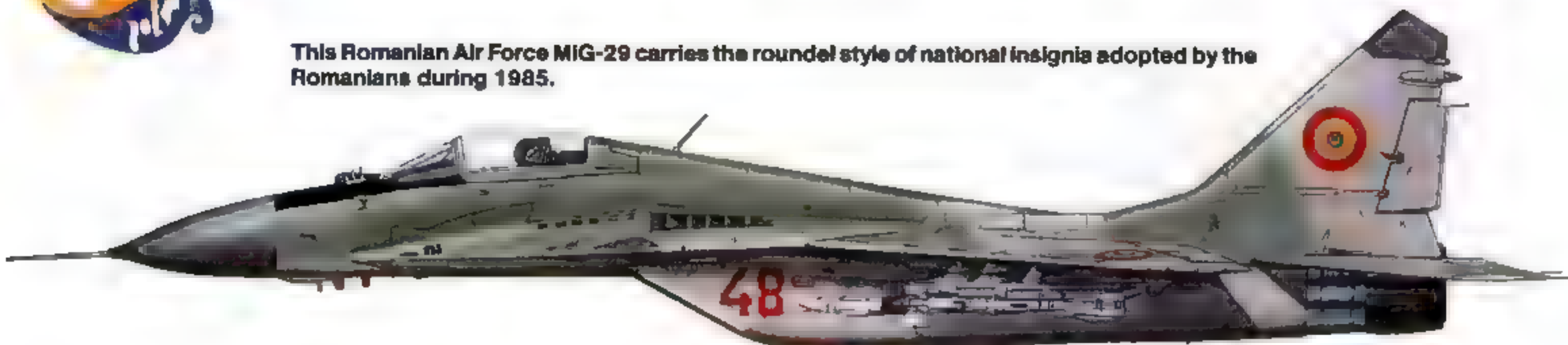
The German Air Force has taken over all former East German Air Force MiG-29 Fulcrum As and MiG-29UB Fulcrum Bs, including 29+20 (formerly known as Red 785).



This Polish Air Force MiG-29 is armed with a mix of AA-10 medium range (inboard pylons) and AA-11 short range (outboard pylons) air-to-air missiles.



This Romanian Air Force MiG-29 carries the roundel style of national insignia adopted by the Romanians during 1985.



The Fulcrum C has a deeper spine which reportedly houses additional avionics equipment. Fulcrum Cs were deployed with Soviet forces in Germany before reunification.



This MiG-29UB Fulcrum B trainer served with the Czech Air Force. It is unusual in that it carries a low level tactical type camouflage.



White 302, a MiG-29UB Fulcrum B of the Yugoslav Air Force carries the full aircraft serial number (15302) on the fin above the national markings in Black.

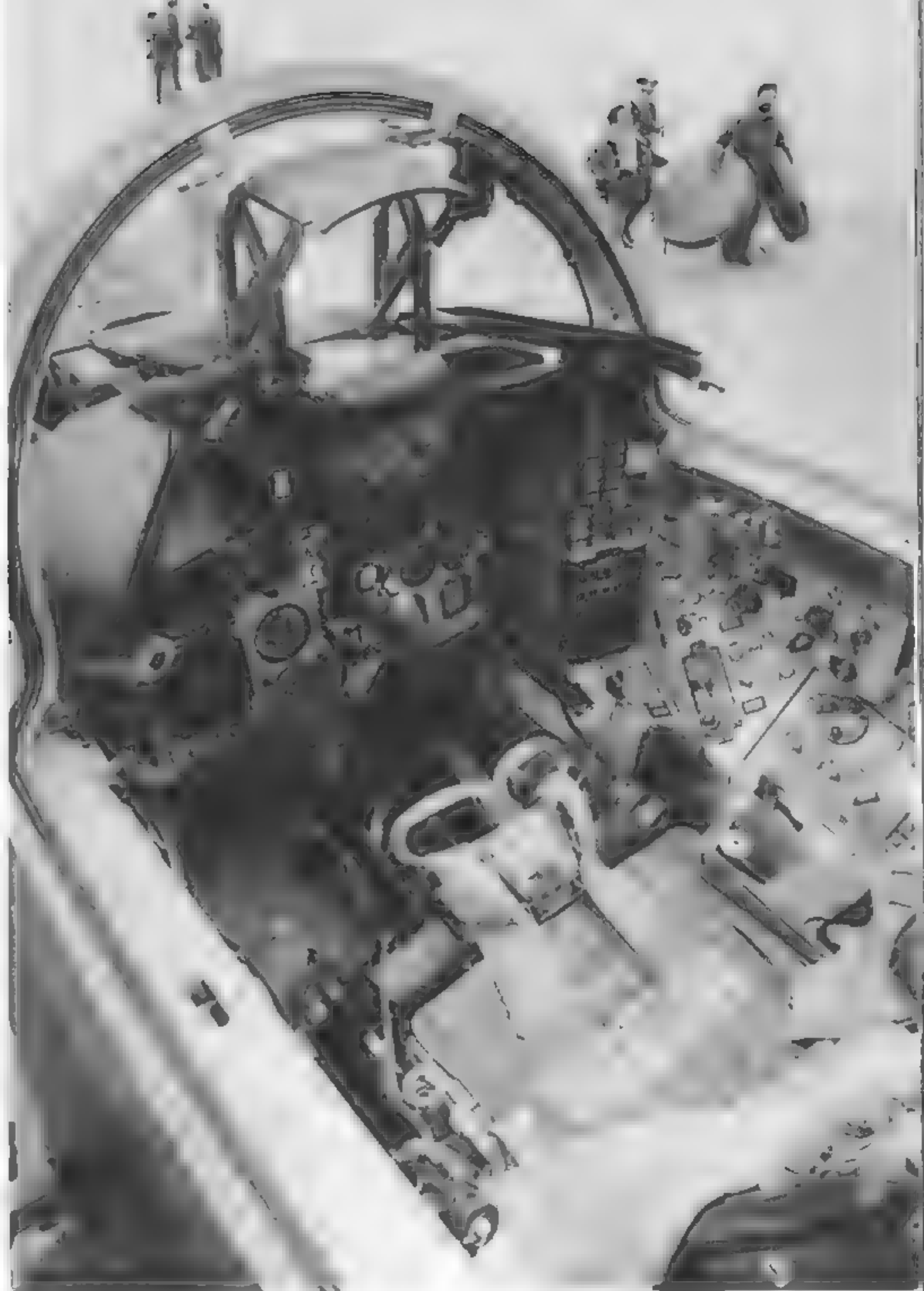




Although the first digit of the tactical number on the air intakes of both these MiG-29 Fulcrum As was overpainted in white, the white tactical number on the fin tip VHF aerial was unaltered. It was not uncommon for the East German Air Force to change tactical numbers on aircraft intended for public view. (Matthias Grunder)

The cockpit of a late production block improved MiG-29 Fulcrum A has a number of changes compared with early production block aircraft. The radar screen on starboard side has a different covering, there is a black hood/shade over the HUD and the control box below the HUD has a different layout.

Ground crew perform the preflight inspection of MiG-29, Red 777, at Preschen Air Base. East German Fulcrums have had a number of the electronic parts replaced by East German parts, in particular the IFF system and parts of the radar. (Wilfried Kopenhagen)





While the crew chief checks out the cockpit, other ground crews standby while fuel is being pumped into this MiG-29 in the fueling pit at Holzdorf Air Base. Fuel is provided through hoses connected to an underground pipeline, a common feature on East German bases. (Harry Wisch)



A ground crewman runs a maintenance check on the pitot tube of MiG-29, Red 699. In addition to the wire running to the pitot tube, the Fulcrum has a number of other electronic leads plugged into it including the Intercomm (under the nose) and EKRA electronic maintenance check system (wing root). (FOTAG)

A late production block MiG-29 Fulcrum A, Red 745, of the East German Air Force on the taxiway at Holzdorf Air Base on 6 June 1990. This aircraft carries the "Winged Q" emblem on the nose, denoting excellent maintenance. The arrows on the fuselage below the cockpit are Yellow rescue markings. (Harry Wisch)



This MiG-29 has a Yellow boarding ladder and Red work platform hooked up to the side of the fuselage. The upper fuselage air louvers are covered with a protective cover which is in Red. The padded canopy cover, boarding ladder, air louver cover and other protective covers all carry the aircraft's tactical number (777) on them in Black. (Wilfried Kopenhagen)





Two East German Air Force MiG-29s, Red 786 and Red 785, of Jagdfliegergeschwader 3 *Wladimir Komarow* on the ramp at Preschen Air Base. East German pilots have praised the excellent handling characteristics of the Fulcrum. Both aircraft are assigned to WTD-61 at Manching. (Matthias Grunder)



A ground crewman inspects the speed brake and braking parachute housing on this East German MiG-29, Red 777, at Preschen. The protective cover over the air louvers (left) has the aircraft tactical number and cover position (777L) painted on it in Black. (Wilfried Kopenhagen)

The East German Air Force painted this MiG-29 with a commemorate paint scheme for its last flight in East German service. On 27 September 1990, LTCOL Gunther Fichte took off for the aircraft's last flight in East German insignia. The aircraft also carried the unit badge on the fin. (Werner Greppmeier)





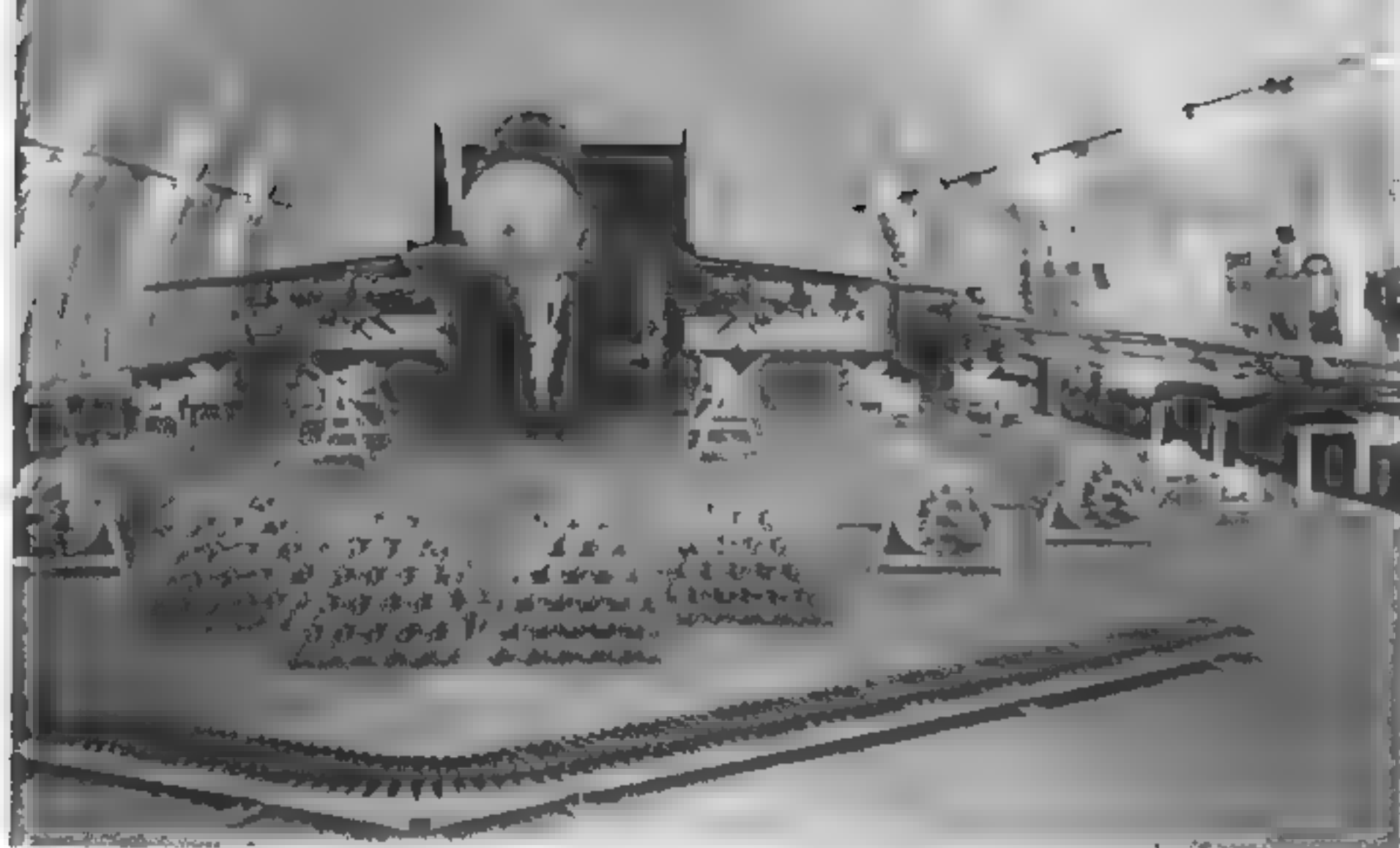
This MiG-29 Fulcrum A, 29+20, on the ramp at Manching Air Base has an AA-11 Archer missile simulator on the wing pylon and a West German tow bar attached to the nosewheel. The missile simulator has the full electronics of a live weapon, but has no rocket motor or warhead. (Harald Ziewe)

This MiG-29, 29+14, (formerly Red 884) is parked in a hardened aircraft shelter and is armed with the standard air-to-air missile load for an interception mission. All the missiles have Red protective covers over the seeker heads on the nose of the missile. The new German number was painted in the same position as the old tactical number on a patch of Light Blue paint.



East German Air Force maintenance men perform squadron level maintenance on Red 888, a MiG-29 Fulcrum A. The aircraft is on jacks and the engine access panels have been removed. (Wilfried Kopenhagen)





Shortly after reunification, this German MiG-29 (29+14) was displayed along with some of the various weapons the aircraft could carry. Air-to-air missiles were on the under wing pylons and in front of the aircraft and the alternate air-to-ground rocket pods (with their rockets) were displayed in front of these, along with the ammunition of the internal cannon. (Wilfried Kopenhagen)

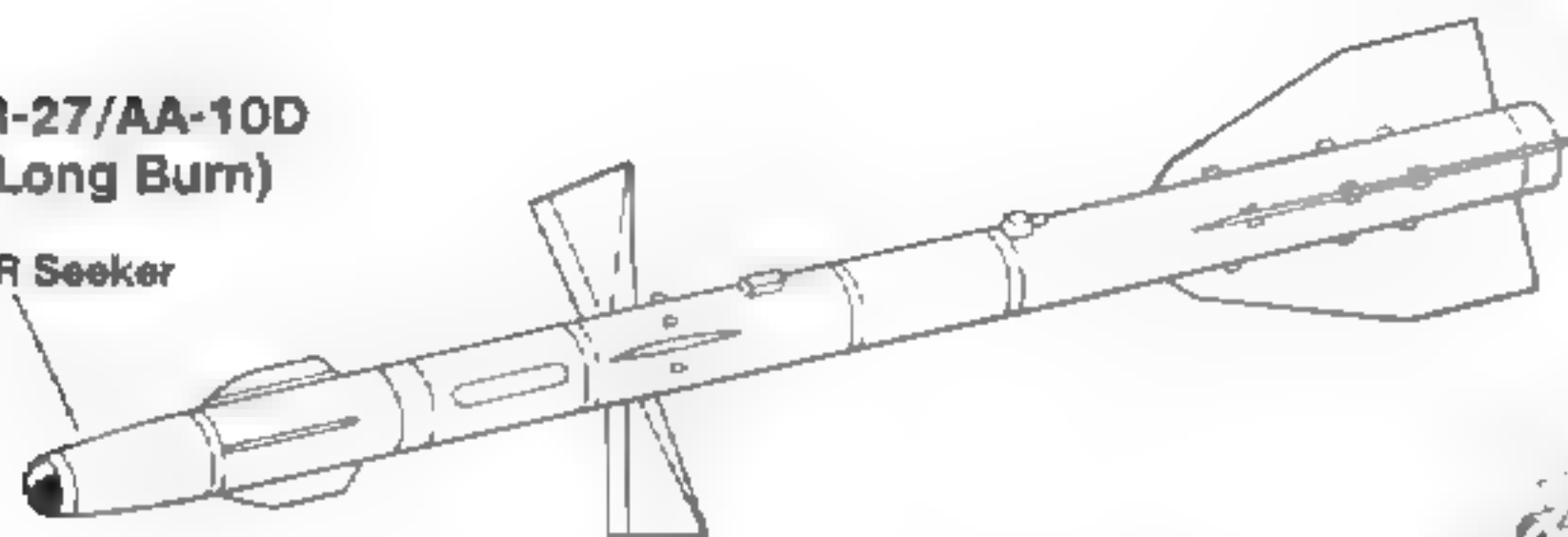


The last MiG-29 Fulcrum A taken over by the German Air Force (29+21) makes its final approach for landing at Manching Air Base. The aircraft was formerly Red 786 with the East German Air Force and still carries this number on the fin tip in White. (WTD-61)

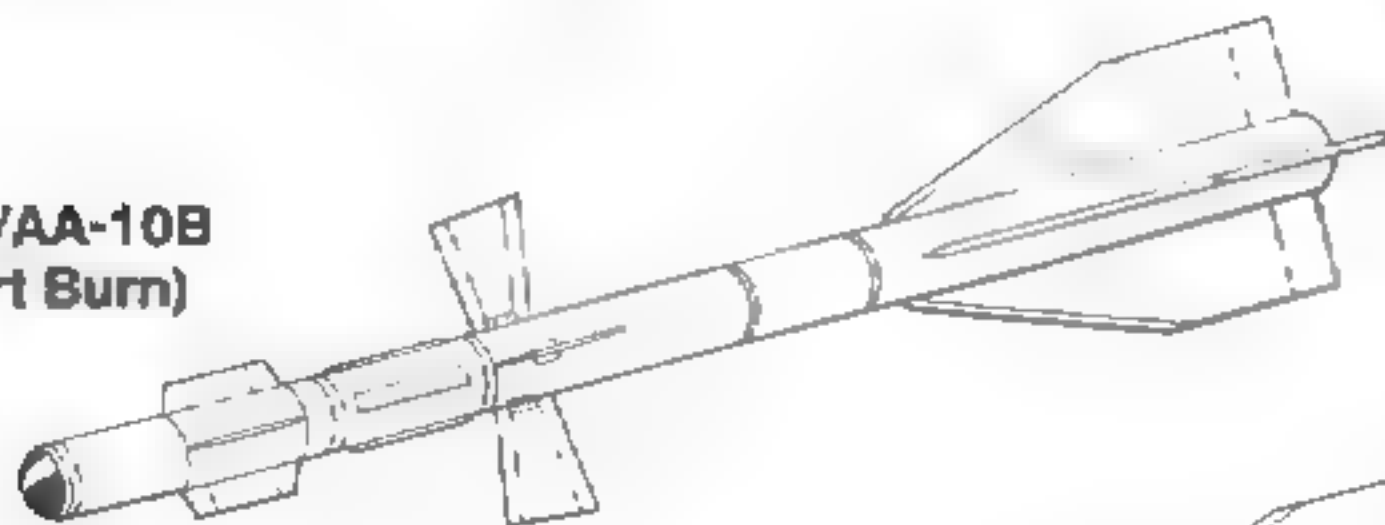
Fulcrum Weapons

R-27/AA-10D
(Long Burn)

IR Seeker

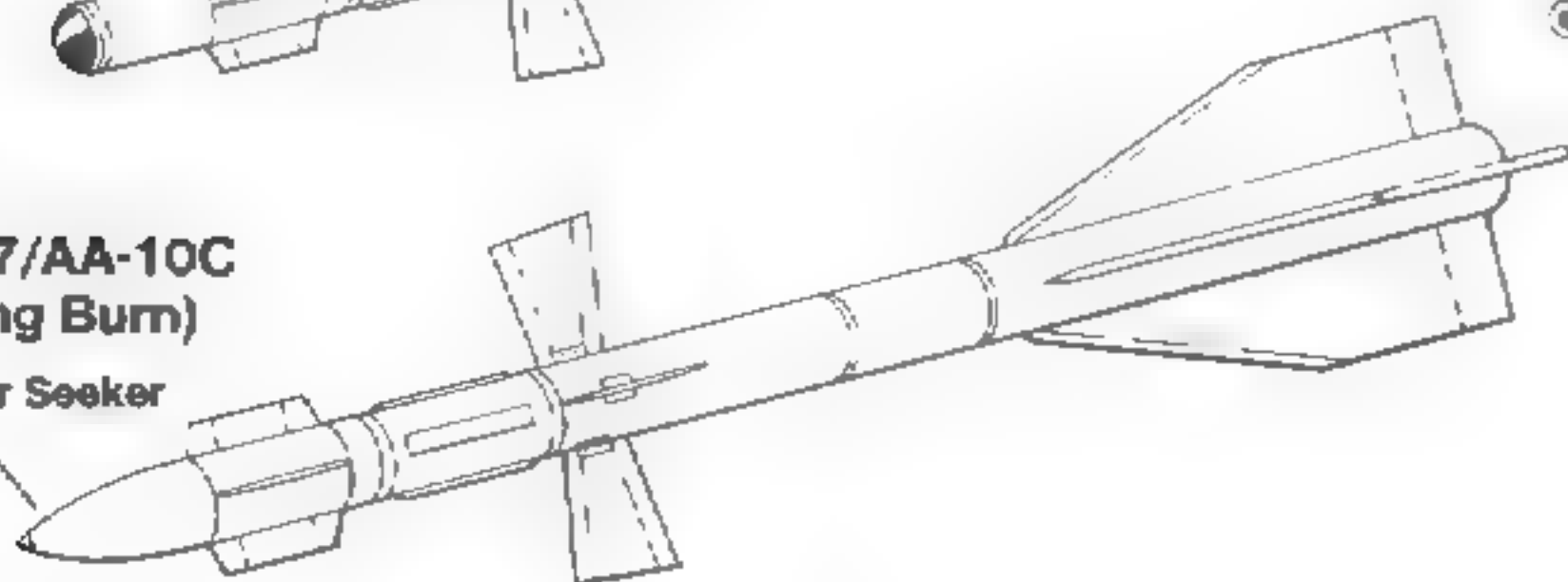


R-27/AA-10B
(Short Burn)



R-27/AA-10C
(Long Burn)

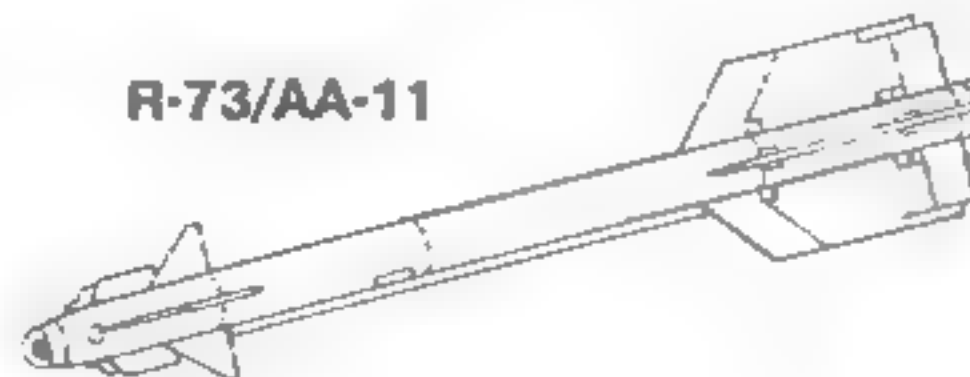
Radar Seeker



R-60MK/AA-8



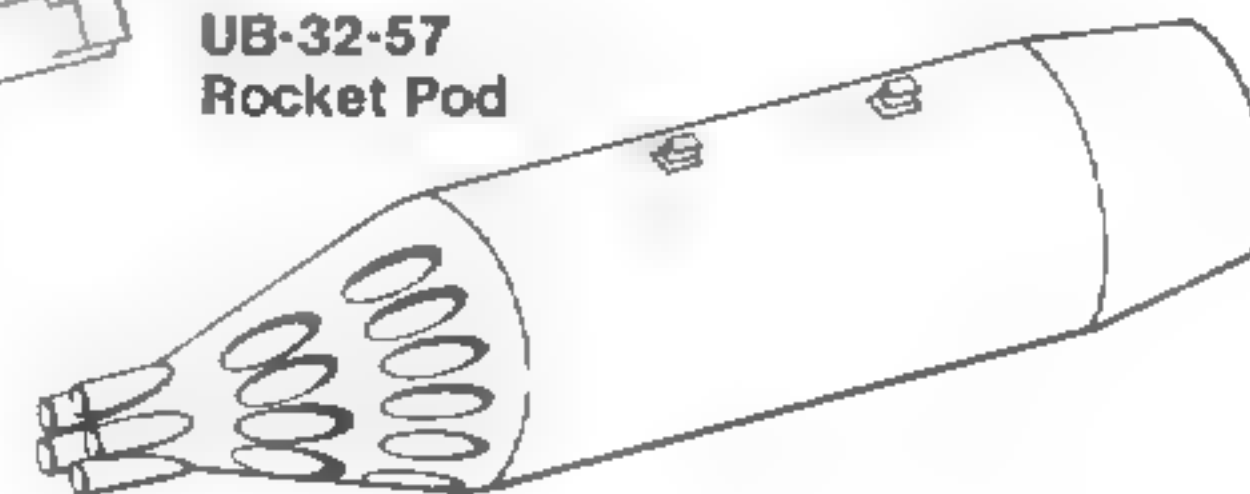
R-73/AA-11



UB-16-57
Rocket Pod



UB-32-57
Rocket Pod





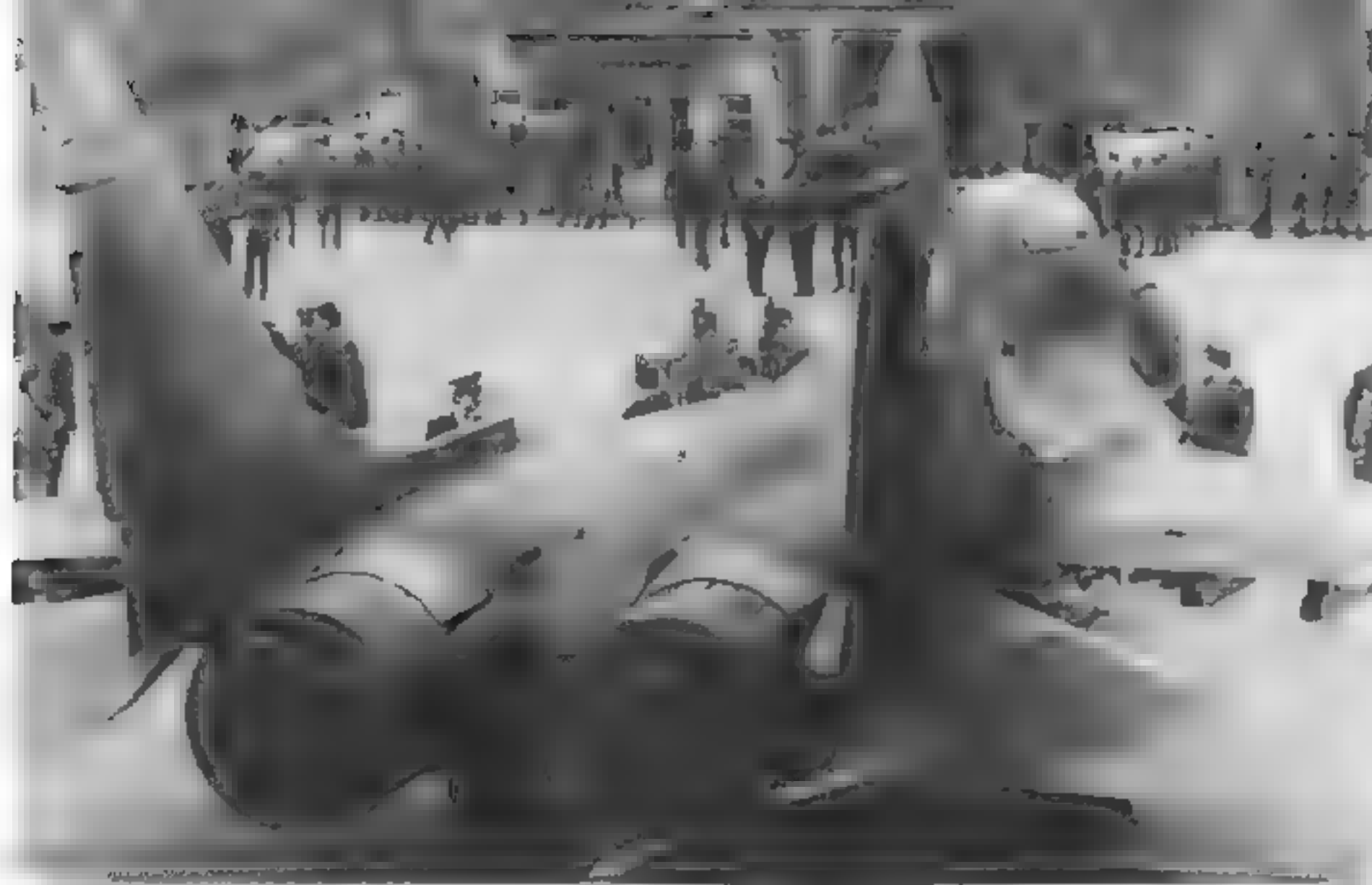
This MiG-29, Black 9308, is assigned to 11 Strihací Letecký Pluk (No 11 Fighter Interceptor Regiment) at Ceske Budejovice. This was the first, and probably last, Czech unit to be equipped with the MiG-29. During January of 1990, Defense Minister Miroslav Vacek stated that there will be no further MiG-29s purchased. The aircraft are based at Zatec.



A Czech Air Force MiG-29, Black 9308 takes off from Ceske-Budejovice Air Force Base during its first public air show. The MiG-29 has a takeoff run of some 790 feet and is airborne in under ten seconds. Like the East Germans, the Czech Air Force used the low level tactical type camouflage.

Black 5817 is a late production block improved MiG-29 Fulcrum A of the Czech Air Force. All Czech MiG-29s carry the low level tactical camouflage known as Central European camouflage with Black tactical numbers (outlined in White). (Simon Watson via Flying Colors)





A MIG-29 of the No 11 Fighter-Interceptor Regiment during the aircraft's official introduction into Czech Air Force service on 17 September 1989. The aircraft are based at Zatec and will most likely be the only MIG-29s to see service with the Czech Air Force.



A Polish Air Force MIG-29 (serial 26 367), Red 67, lands at Minsk-Mazowiecki Air Base with the drag chute fully deployed. The Tan braking parachute will reduce the landing run to approximately 1,970 feet. (Polish Air Force)

Two Polish Air Force MIG-29s perform a section takeoff from Minsk-Mazowiecki Air Base located twenty miles east of Warsaw. Both aircraft carry Red tactical numbers, Red 67 is serial 26 367 and red 70 is serial 26 370. (Polish Air Force)



Two MIG-29s of the 1 *Pulk Lotnictwa Myskiwskiego* (1st Fighter Regiment) make a low pass over Minsk-Mazowiecki. Due to the country's high inflation rate, the price paid by the Polish Air Force for MIG-29s has skyrocketed. During 1989 the price was 19.1 million Zlotys per aircraft — by early 1990 the price was up to 39.6 million Zlotys (\$1 US equals 9,350 Zlotys).





A MiG-29 Fulcrum A and a MiG-29UB Fulcrum B share the ramp at Kogalniceanu Airport near Constanta on the Black Sea with a MiG-23UM Flogger C and MiG-23MF Flogger B. The roundel style national marking was reintroduced during 1985, replacing the Soviet style Red star type insignia.

A Romanian Air Force MiG-29 Fulcrum A, Red 46, shares the ramp at Bucuresti-Baneasa airfield south of Bucharest on 1 July 1990 with a MiG-29UB trainer, Red 23. The air force had intended to present the aircraft at an air show scheduled for 17 June; however, riots in Bucharest on 13 June led to the show being cancelled.



Romania received their first MiG-29 Fulcrum As during November of 1989, shortly before the revolution. During the Summer the aircraft were deployed from Kogalniceanu Airport to Janca Air Base southwest of Braila. The aircraft all carry standard Soviet air superiority camouflage with Red tactical numbers.

This MiG-29 Fulcrum A is assigned to the Bulgarian Air Force. The Bulgarians received their first MiG-29s during early 1990. All Bulgarian Fulcrums carry standard Soviet air superiority camouflage with White tactical numbers. (Wojciech Luczak)



MiG-29M Fulcrum C

In order to install a number of improved electronics systems in the MiG-29, the MiG-OKB began work on an improved variant with enhanced electronics housed in an enlarged dorsal spine behind the cockpit under the designation MiG-29M.

While the overall length of the fuselage and the wing span were retained, the MiG-29M differed from the standard Fulcrum A by the enlarged dorsal spine, and the lack of the chaff/flare dispenser sensor blister on the fuselage upper surfaces.

The first MiG-29M was spotted by NATO during the Summer of 1987 at Kubinka airfield during an open house for the families of air force personnel and high ranking politicians. A short time later the aircraft was given the NATO reporting name Fulcrum C.

The MiG-29M has not been exported outside the Soviet Union, although during 1989 a number of Fulcrum Cs were deployed to Chojny Air Force base near Szczecin in Poland while other aircraft were spotted in East Germany.

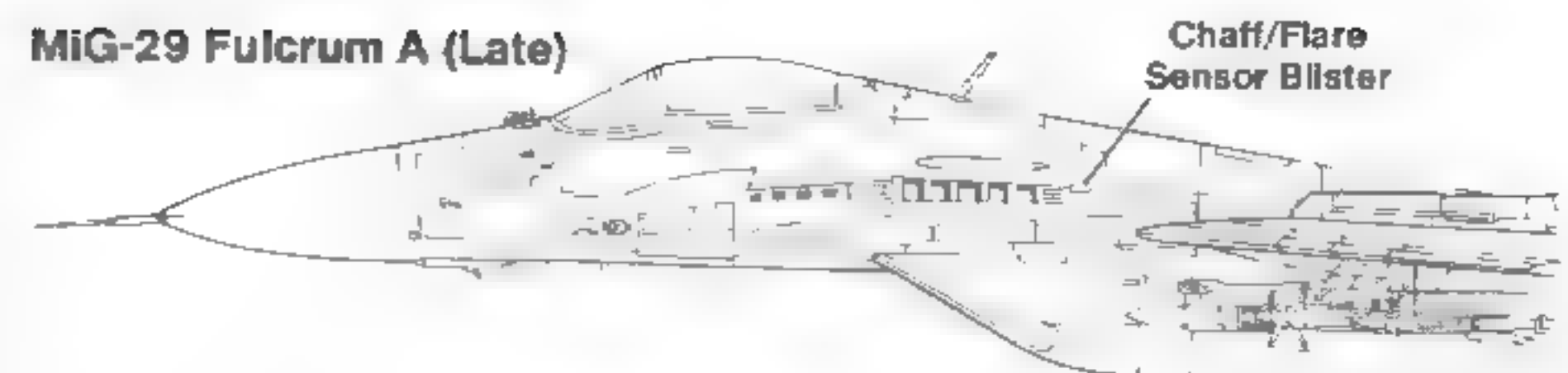
It is believed that Fulcrum As will be upgraded to MiG-29M standards when the aircraft are returned to the factory for overhaul and reconditioning. There are also rumors that India has announced a requirement for twenty-four Fulcrum Cs. Some statements coming from Indian officials seem to infer that the Fulcrum C has an enhanced ground attack capability; although, at this time, there is no confirmation of this.

Additionally, there are ongoing efforts to further upgrade the MiG-29M with a modular fly-by-wire (FBW) system. An experimental version of the MiG-29 with a FBW system was tested during early 1989 with MiG chief test pilot Valerij Menitskij conducting a number of test flights.

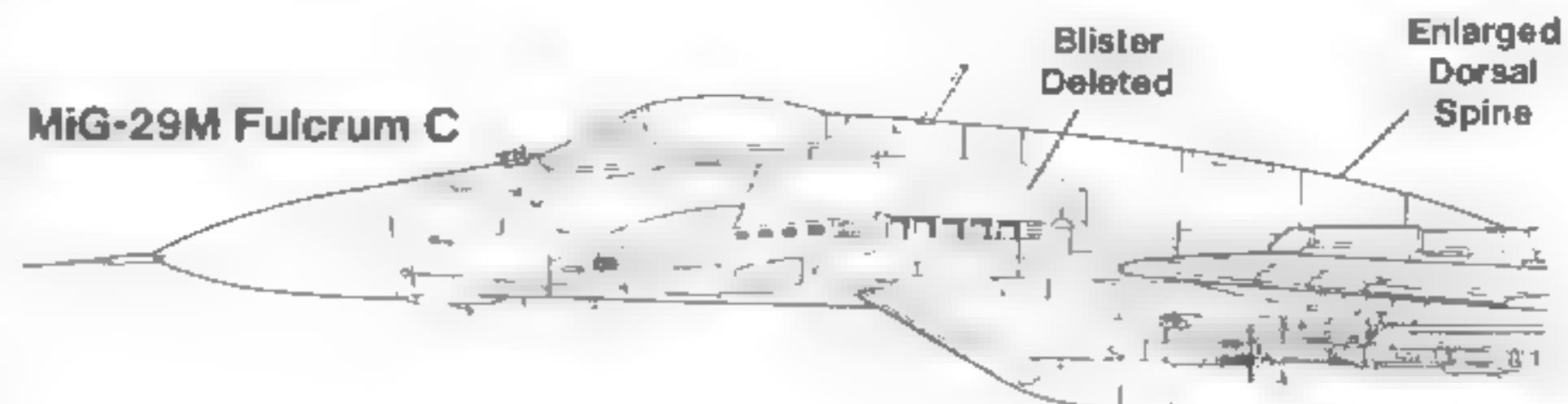
There are also plans to enhance the cockpit instrumentation with video CRT displays replacing the analog instruments, giving the MiG-29 a cockpit layout similar to that of the McDonnell-Douglas F/A-18 Hornet.

Fuselage Development

MiG-29 Fulcrum A (Late)

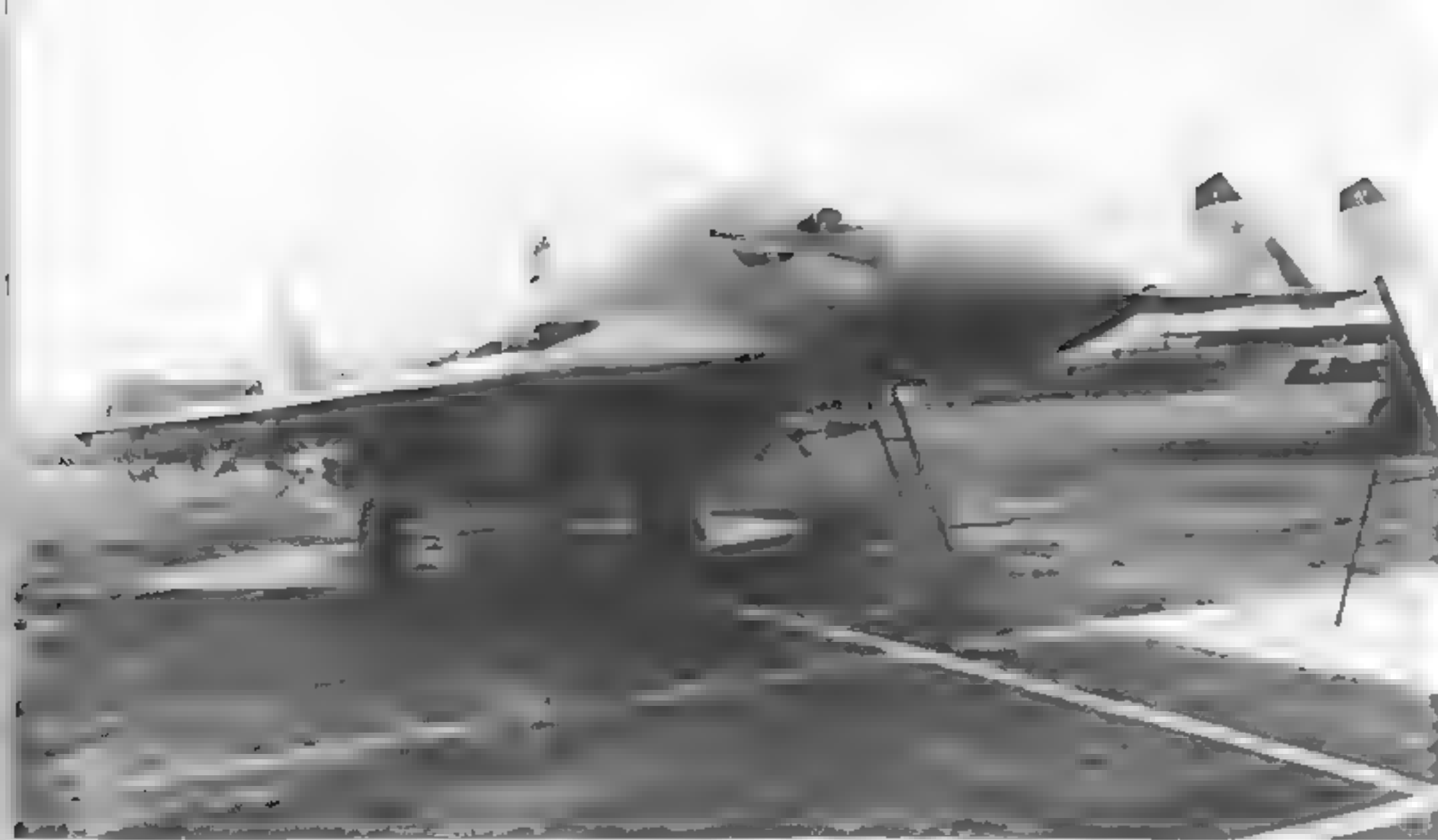


MiG-29M Fulcrum C



Blue 01, a MiG-29M on the ramp at Kecskemet Air Base in Hungary during August of 1990. The aircraft is unusual in that it is carrying a small "Guards" emblem on the air intake in front of the tactical number. This emblem is only carried by units that can trace their history back to the Second World War.





This MIG-29M Fulcrum C was one of the first to be deployed outside the Soviet Union. During February of 1990, a number of Fulcrum Cs deployed to Chojny Air Base in Poland. The aircraft is carrying the standard armament of R-60, R-73 and R-27 air-to-air missiles.



A MIG-29M Fulcrum C, Blue 28, shares the ramp at a Soviet base with an Sukhoi Fitter K. The MIG-29M featured an enlarged dorsal spine which housed additional electronics equipment and gave the aircraft a humpedback appearance.

On 19 August 1990, USAF F-16s and Soviet Air Force MIG-29M Fulcrum Cs shared the ramp at Kecskemet Air Base in Hungary. This was the first time Soviet and American aircraft have shared a base in Europe since the end of the Second World War. (Fred Willemssen)



MiG-29K Fulcrum D

With the introduction of the aircraft carrier TBILISI into first line service with the Soviet Navy, it quickly became evident that a fleet air defense fighter was needed.

The design of a carrier based fighter had never been undertaken in the USSR and both MiG and Sukhoi were approached with the problem simultaneously. Sukhoi developed a variant of the Su-27 Flanker known as the T-10.24 prototype (basically a navalized Su-27). The MiG-OKB choose to develop a navalized variant of the MiG-29 to serve as its entry for a Navy carrier fighter.

Development of the naval MiG-29 required some ten years and during 1987 the first flight tests were carried out with the aircraft taking off from a dummy carrier deck marked out on a runway at Saki naval airfield on the Crimean Peninsula.

The navalized Fulcrum variant, is designated the MiG-29K (K for *Korabelnij*, Carrier based). The MiG-29K differs from the standard MiG-29 in a number of ways. The prototype, Blue 311, has no chaff/flare dispenser extensions on the vertical fin and the infrared search-and-track sensorIRST system in front of the cockpit appears to have been modified.

The navalized MiG-29K has folding wings for below deck storage and to reduce parking space requirements. There are bulbous housings on the wingtips which are believed to house new electronic surveillance antennas. The aircraft has the air inlet anti-FOD doors deleted as well as the upper surface air intake louvers. Additionally, the aircraft has the chaff/flare dispenser sensor blister deleted.

The cooling air intake on the port side engine nacelle has been relocated to the starboard engine nacelle and enlarged. A small electronics blister is installed on the port side of the forward fuselage, just in front of the windscreen. For carrier operations, the undercarriage was strengthened and an arrestor hook was installed under the rear fuselage.

The MiG-29K has a new radio communications system and an improved helmet sighting system, together with a new armament fire control computer.

Internal fuel capacity of the MiG-29K was increased from 1,153 gallons to 1,800 gallons. Reportedly the MiG-29K is also capable of inflight refueling, although this is not confirmed.

The first landing of a conventional take-off/landing (CTOL) aircraft on a Soviet carrier took place on 21 November 1989. The privilege of being the first Soviet pilot to perform a carrier landing was given to Viktor Pugachev flying the Sukhoi T-10.24. He was followed ninety minutes later by the First Class test pilot and Hero of the Soviet Union Toktar Aubakirov flying the MiG-29K. Later that same day, Aubakirov made the first successful carrier takeoff in Soviet Navy history. Shortly after these tests, NATO gave the MiG-29K the reporting name Fulcrum D. The trials revealed that the T-10.24 was better suited to the carrier role than the MiG-29K and as a result, only one MiG-29K was built.



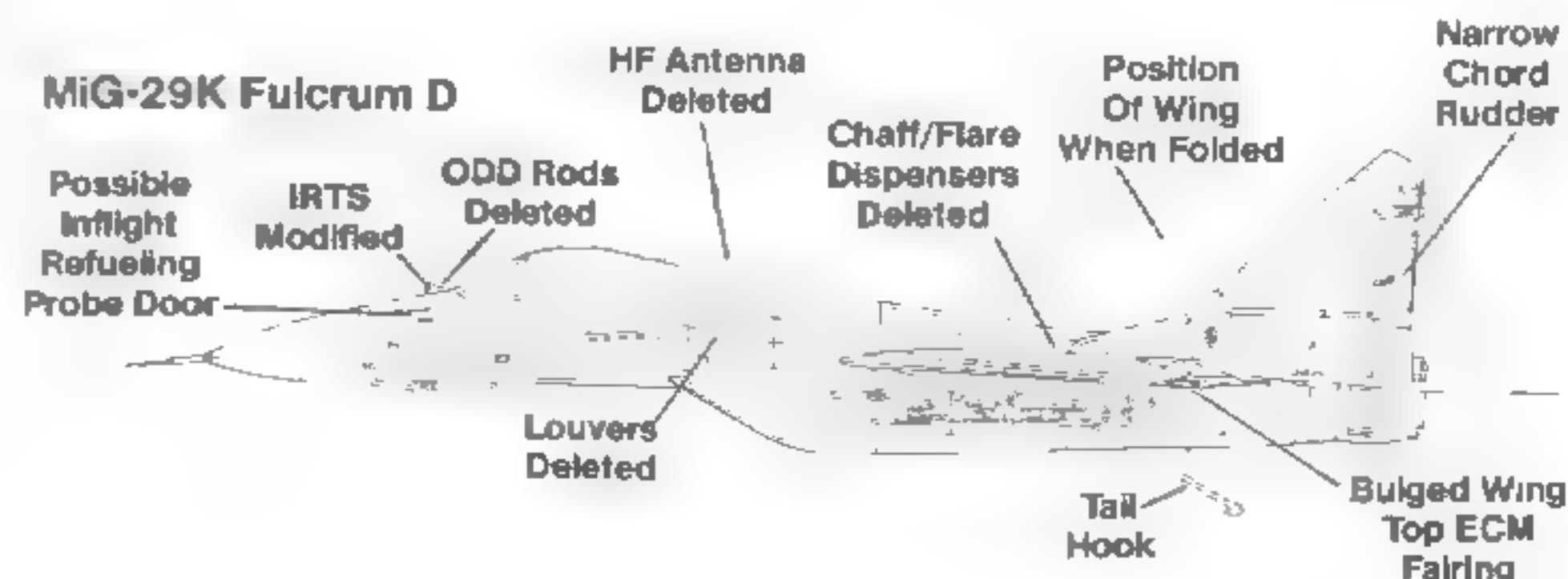
The MiG-29K Fulcrum D was tested at sea aboard the Soviet aircraft carrier TBILISI. On 21 November 1989, a MiG-29K flown by Toktar Aubakirov made the first conventional landing aboard a Soviet carrier by a Soviet fighter aircraft. The MiG-29K has folding wingtips to allow it to use the elevators on the ship.

Fulcrum D

MiG-29 Fulcrum A (Late)



MiG-29K Fulcrum D



MiG-29UB Fulcrum B

The development of the two seat trainer variant of the Fulcrum was undertaken almost simultaneously with the single seat MiG-29 fighter. This was a departure from normal Soviet tradition where trainer variants were often developed years after the single seat aircraft was in operational service.

The MiG-29UB (UB - *Uchebny Boyevoy*, Combat Trainer) has a stretched forward fuselage redesigned to accommodate a second cockpit.

The MiG-29UB has the rear seat raised to improve the view from the rear cockpit for the instructor. To make room for the second cockpit, the pulse doppler radar was deleted, although a laser range finder and the small ranging radar was installed in the aircraft's nose. Even without the larger radar, the MiG-29UB is capable of carrying the same range of weapons as the Fulcrum A and is fully combat compatible.

Although the rear seat is raised, the instructor's cockpit retains a periscope similar to those mounted on other MiG two seat trainers. The periscope closes automatically when the landing gear retracts and opens when the gear is lowered. Two large rear view mirrors are also fitted on the instructor's canopy frame.

There were a number of other changes on the MiG-29UB. The HF aerial behind the canopy was repositioned to the rear, the angle of attack transmitter on the fuselage side was relocated to the rear, the upper nose Odd Rods IFF antenna found on the Fulcrum A was deleted and the Odd Rods antenna and the yaw vane under the nose were moved forward.

Additionally, the MiG-29UB was never fitted with chaff/flare dispensers and, although the MiG-29UB is capable of carrying three wing pylons, these are normally removed by operational units with two or one pylon normally being fitted. Recently the Odd Rods antenna under the fuselage was exchanged for the blade style IFF antenna.

A Soviet Air Force MiG-29UB Fulcrum B taxis in after another training sortie with the braking parachute door open. The aircraft carries the same air superiority camouflage as the single seat MiG-29 Fulcrum A fighters.

A further improvement was included in MiG-29UBs which left the production line during early 1989. Instead of four cannon bay vent louvers on the fuselage, these late production MiG-29UBs have two small forward vents and two large rectangular cannon bay air vents. All these aircraft also had the same cannon blast suppression air duct/exhaust port as late MiG-29 Fulcrum As. Additionally, like the Fulcrum A, the MiG-29UB was also progressively upgraded with new electronics.

The MiG-29UB was first unveiled to the West when the Indian Air Force demonstrated the aircraft. At that time NATO assigned the aircraft the NATO reporting name Fulcrum B.

The MiG-29UB is used as a proficiency trainer to improve the skills of proven Fulcrum pilots. Normally, two to four MiG-29UB trainers are allocated to each fighter squadron.

The MiG-29UB has been exported to India, Syria, Iraq, Yugoslavia, East Germany, Czechoslovakia, Poland, Romania, North Korea and Cuba. Like the fighter variants, most Fulcrum Bs are painted in the air superiority Gray camouflage scheme. The exceptions are Czech Air Force MiG-29UBs which carry the Central European camouflage of two Green shades and two Brown shades. Three of the four East German Air Force MiG-29UBs carry the air superiority Gray paint scheme, while a single MiG-29UB carries the Central European camouflage.

Normally, two to four MiG-29UBs are delivered along with Fulcrum As to export customers. These aircraft were used by Soviet instructor pilots to train new pilots on the Fulcrum and to conduct combat/weapons training in their home country since this type of training is not conducted during conversion training in the Soviet Union.

This MiG-29UB Fulcrum B is right off the production line and has not yet been painted with national insignia. The aircraft is configured with a single underwing pylon at the outboard position. The MiG-29UB was introduced into service at near the same time as the MiG-29 Fulcrum A.

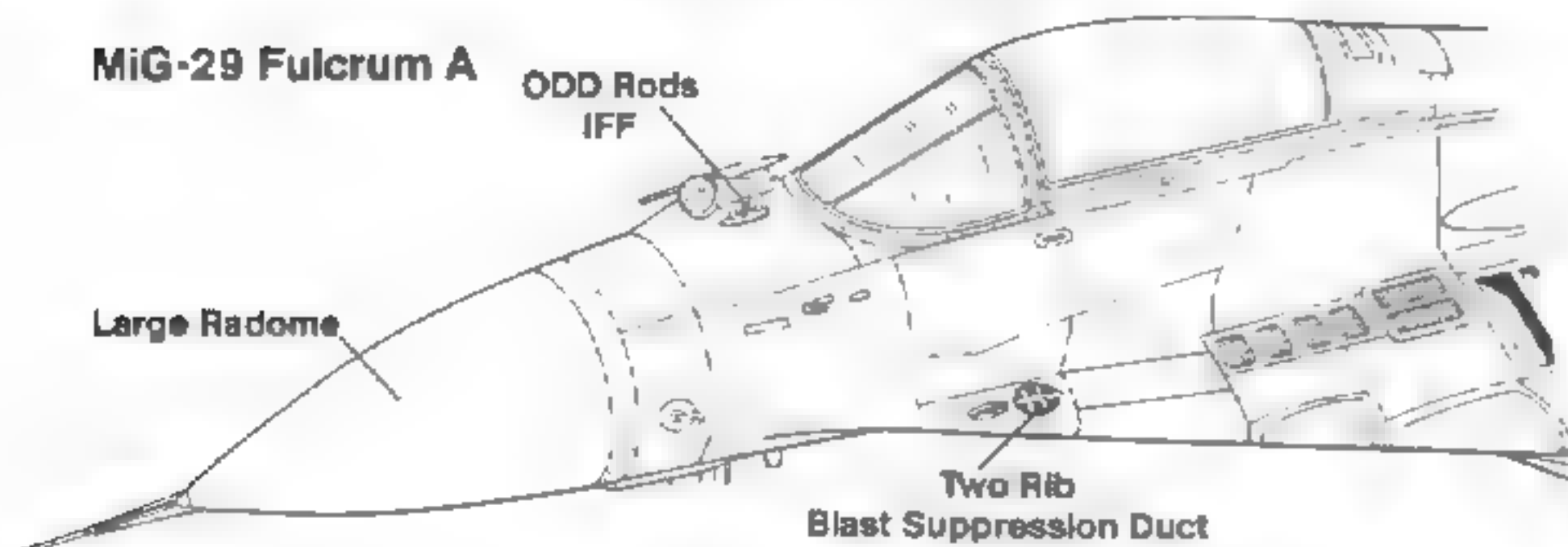




Fuselage Development

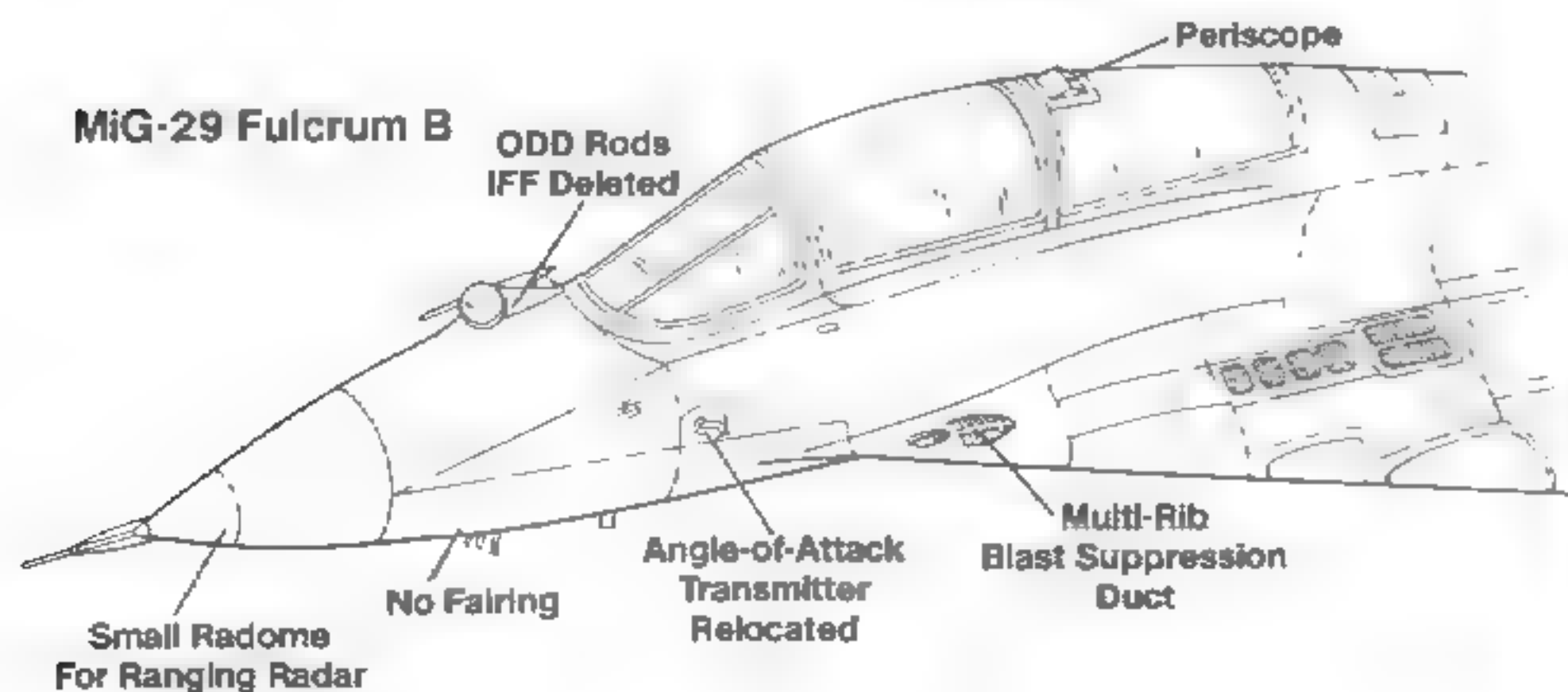
This MiG-29UB (serial 16 302), White 302 of the Yugoslav Air Force is an early production aircraft with a three pole ODD Rods IFF antenna under the nose. In contrast with the Fulcrum A, the Fulcrum B trainer has no IFF antenna above the nose. (Milar Micevski)

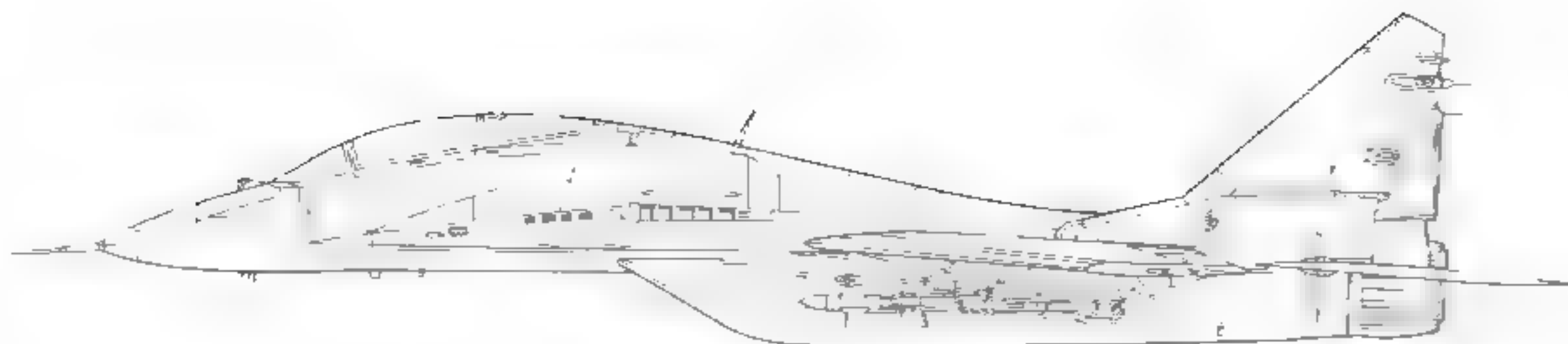
MiG-29 Fulcrum A



A MiG-29UB Fulcrum B of the Yugoslav Air Force on the taxiway of its home base. The fin markings consist of (top to bottom) Blue - White - Red stripes with a small Red star centered on the White stripe. Tactical numbers on Yugoslav MiG-29s are White.

MiG-29 Fulcrum B



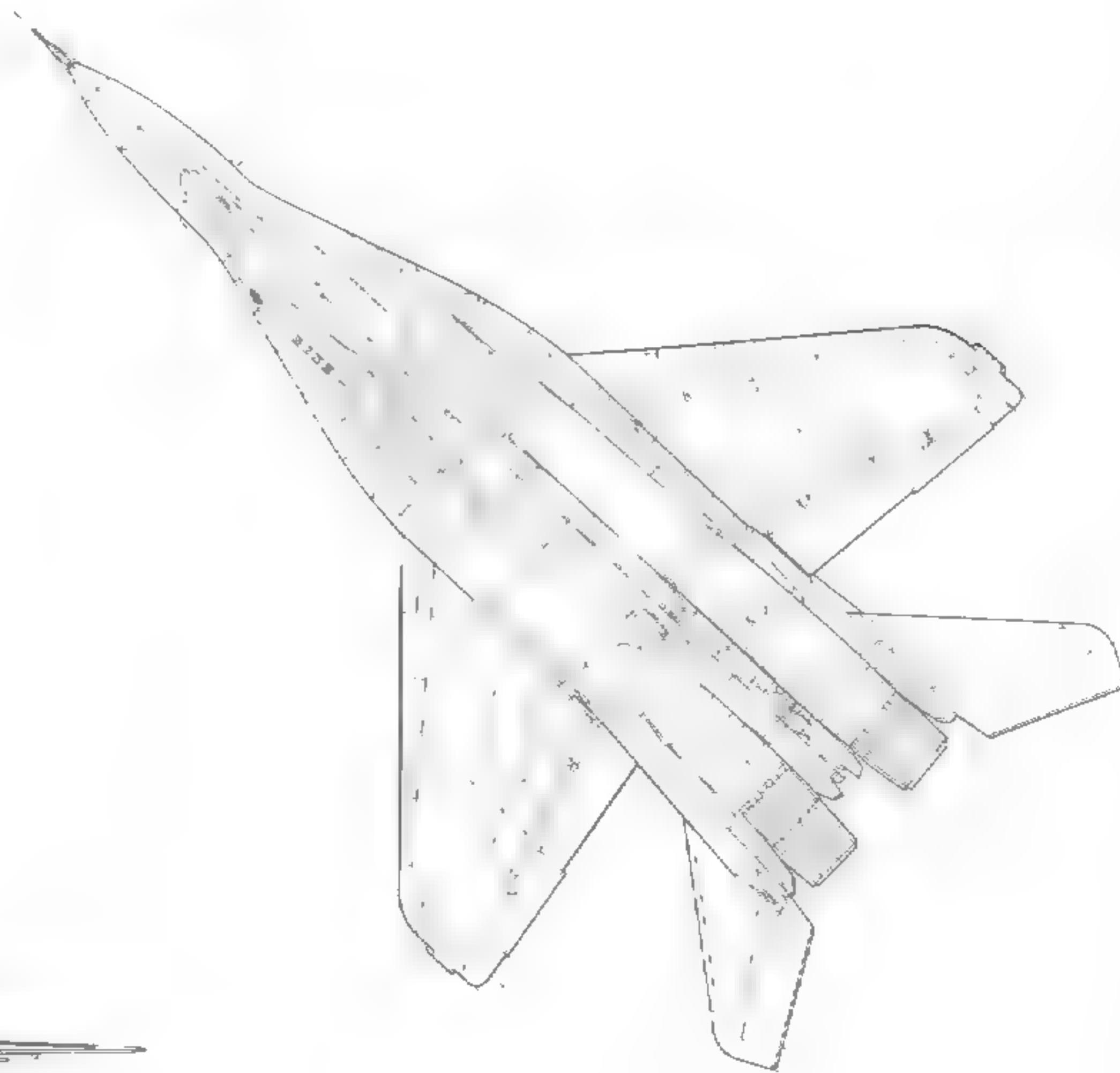
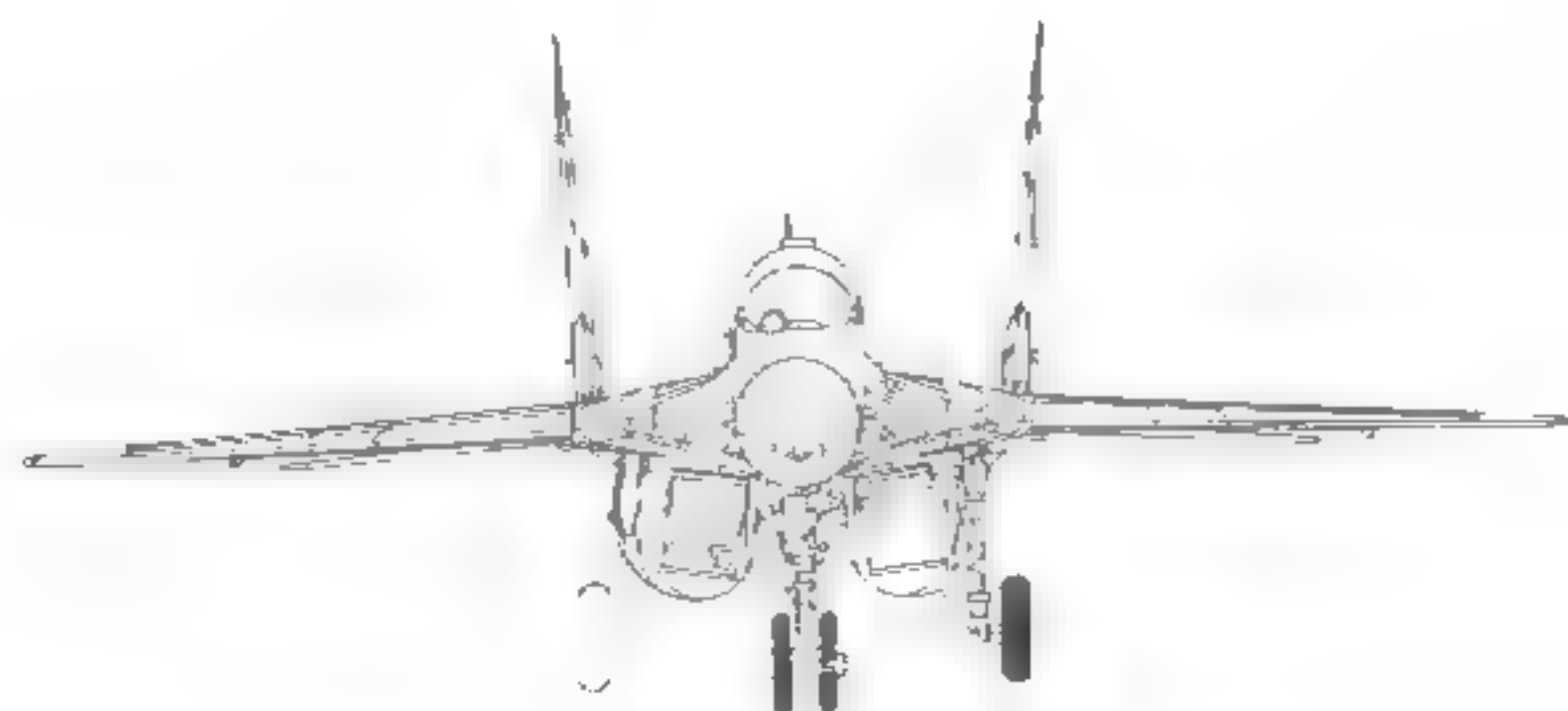


Specifications

MiG-29UB Fulcrum B

Wingspan	37 feet 4 inches
Length	57 feet 2 inches
Height	15 feet 6 inches
Empty Weight	18,025 pounds
Maximum Weight	39,000 pounds
Powerplant	Two 18,300 lbf Izotov R-33D turbofan engines
Armament	One 30MM GSh-301 cannon Two R-60 (AA-8) Aphid Two R-73 (AA-11) Archer Two R-27 (AA-10) Alamo air-to-air missiles

Performance	
Maximum Speed	1,320 mph
Service ceiling	56,000 feet
Range	1,130 miles
Crew	Two





The instructor pilot mans the rear cockpit while the student flies from the front cockpit. Both cockpits are equipped with K-36DM ejection seats. This aircraft is a late production MiG-29UB. The newer variants of the Fulcrum B have the revised gun blast suppression air duct/exhaust port and two cannon bay vents. (Polish Air Force)



Three Polish Air Force pilots discuss their next mission in front of a MiG-29UB Red 15. This aircraft was one of four Fulcrum Bs in service with the 1st Fighter Regiment. Most Fulcrum pilots in the Polish Air Force are young, under 30 years of age. (Polish Air Force)

A Polish Air Force MiG-29UB, Red 15, on landing rollout at Minsk-Mazowiecki Air Base. The aircraft carries the insignia of the 1st Fighter Regiment on the nose. The aircraft is clean, carrying no underwing pylons. (Polish Air Force)





Ground crew help the flight crew of this MIG-29UB strap into the aircraft's K-36DM ejection seats. East German fighter aircraft carry three digit tactical numbers in Red, while all training aircraft have three digit numbers in Black, a tradition that goes back to 1956. (Wilfried Kopenhagen)

Two mechanics of the 3rd Fighter Group prepare a MIG-29UB, Black 179, for a mission during November of 1989. This aircraft is covered by tarps to protect the canopy. The dielectric panel on the wing LEX has been covered by a Red protective cover with the aircraft's tactical number on it in Black. (Matthias Grunder)

A MIG-29UB Fulcrum B of the Polish Air Force on the ramp of the 1st Fighter Regiment base. Polish MIG-29s do not carry the national insignia on the upper wing. The national insignia is carried on the fin and underside of the wing only.

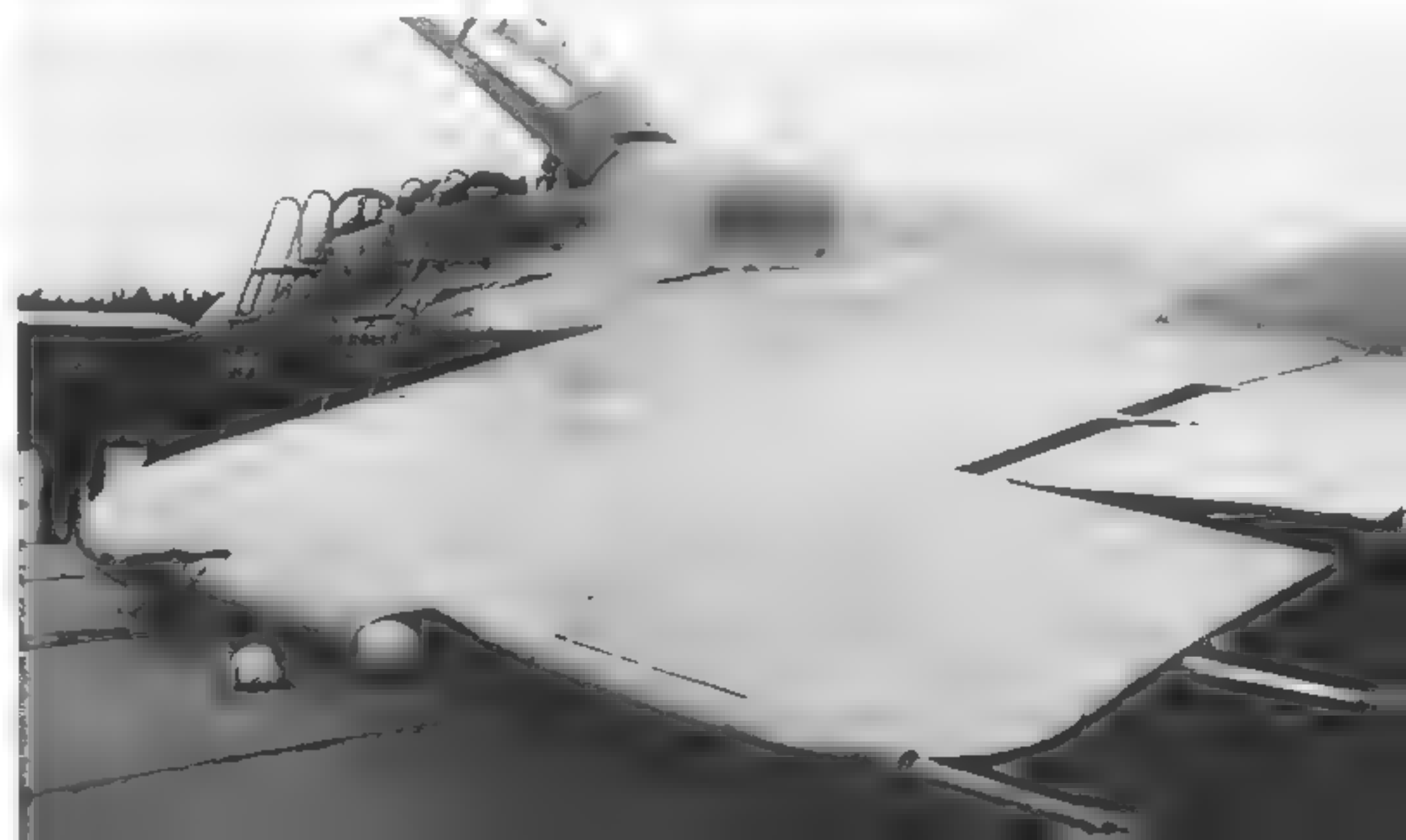




A ground crewman stands by a MIG-29UB, Black 179, as it prepares to leave the parking apron at Preschen. This Fulcrum B carries the *Winged Q* maintenance award badge on the nose in blue and yellow. The yellow arrows on the nose are rescue markings. (Matthias Grunder)

A MIG-29UB Fulcrum B on the ramp at Preschen prior to a mission. The two bars coming back off the wing are static electricity dischargers. The two round objects are the radar warning antenna (rear) and wing tip navigation light (front). (Wilfried Kopenhagen)

This MIG-29UB Fulcrum B was assigned to the 3rd Fighter Regiment *Wladimir Komarow* at Preschen. One of the main differences between the fighter MIG-29s and the trainer Fulcrum B is the lack of chaff/flare dispenser extensions on the MIG-29UB. (Wilfried Kopenhagen)





An East German Air Force MiG-29UB taxis in on the taxiway at Preschen. The object above the canopy is the instructor's periscope which is in the fully deployed position. This particular aircraft carries pylons on the inboard and center positions, while the outboard pylon is not fitted. (Wilfried Kopenhagen)

An East German ground crew preflights a MiG-29UB, Black 179, prior to a mission. This is an early production MiG-29UB with the early style gun blast suppression duct/exhaust. The anti-glare panel in front of the canopy is in black. (Matthias Grunder)



This MiG-29UB Fulcrum B has the air brake open. The round object in the center is the housing for the PTU-29 braking parachute system. In contrast with the Su-27 Flanker with its large air brake on the dorsal spine, the Fulcrum uses a two piece air brake between the engines. (FOTAG/Frobus via Kristina Donath)

With the instructor's periscope in the fully deployed position, a ground crewman directs an East German MiG-29UB, Black 185, to prepare for taxi. The crewman is still connected to the aircraft through a communication wire plugged in under the nose. (Wilfried Kopenhagen)





Black 185 was one of the first MiG-29UBs delivered to the East German Air Force during late 1987. The 3rd Fighter Regiment had a tradition of flying MiG aircraft, having flown the MiG-15, MiG-17, MiG-19, MiG-21 and finally the Fulcrum. (Wilfried Kopenhagen)

An East German Air Force pilot signs off on the maintenance sheet for this MiG-29UB just prior to the start of another training mission. This pilot is wearing the a MiG-29 helmet configured to carry the SUW computerized gun sighting system. (Matthias Grunder)

A ground crewman feeds information from an EKRAN system into the Fulcrum's flight and weapons computers. The EKRAN system also runs maintenance checks on the condition of the aircraft, instruments and other equipment. The system records this data on tape for later study. (Matthias Grunder)

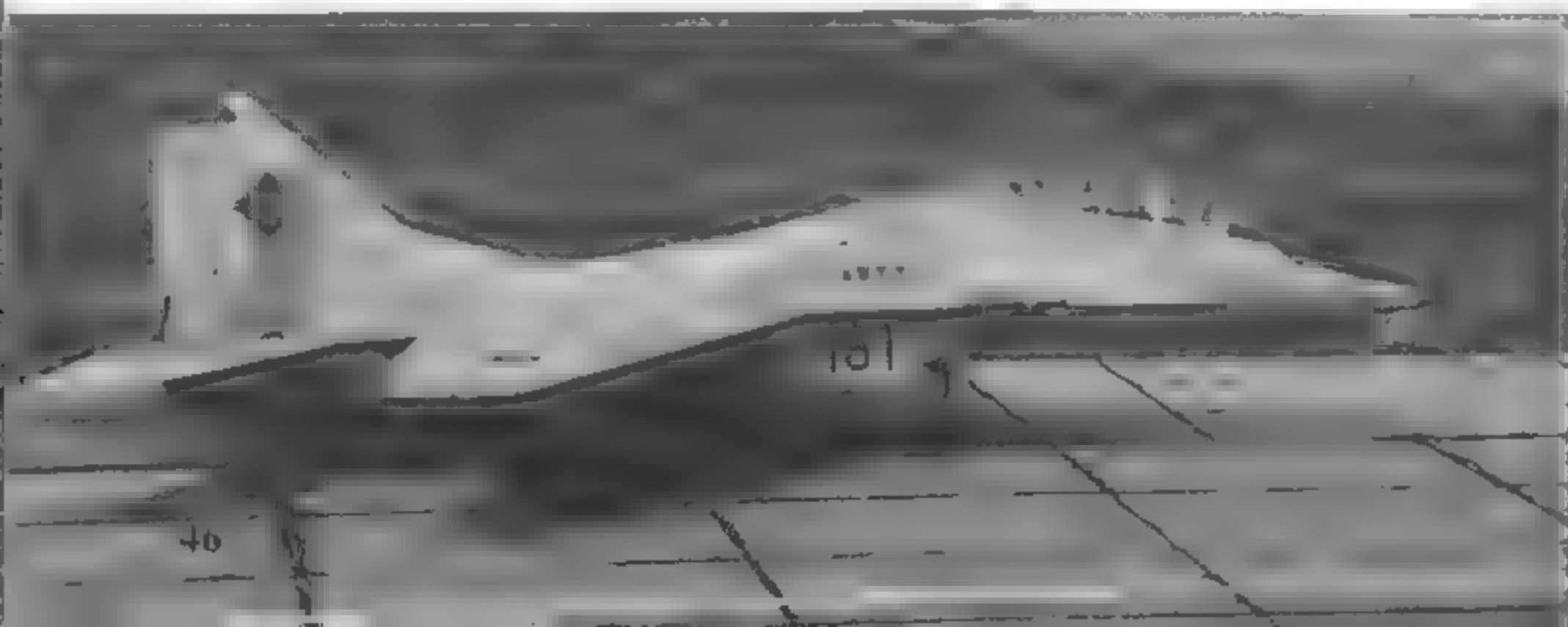




Black 148 is the only MiG-29UB in the East German Air Force to carry the Central European tactical camouflage that was used by the single seat MiG-29 Fulcrum A fighters. The fuel truck in the foreground is a Czech-built TATRA fuel truck. (Wilfried Kopenhagen)

A ground crewman boards an East German Air Force MiG-29UB Fulcrum B. The small round object on the wingtip is the antenna for the radar warning system. This antenna provides detection of hostile radars on the aircraft's port side. Other antennas are positioned to give the aircraft full 360 degree protection. (Wilfried Kopenhagen)

Black 181, A MiG-29UB Fulcrum B of the East German Air Force taxis out for a training mission. All East German trainers carry Black tactical numbers that identify them as training aircraft.

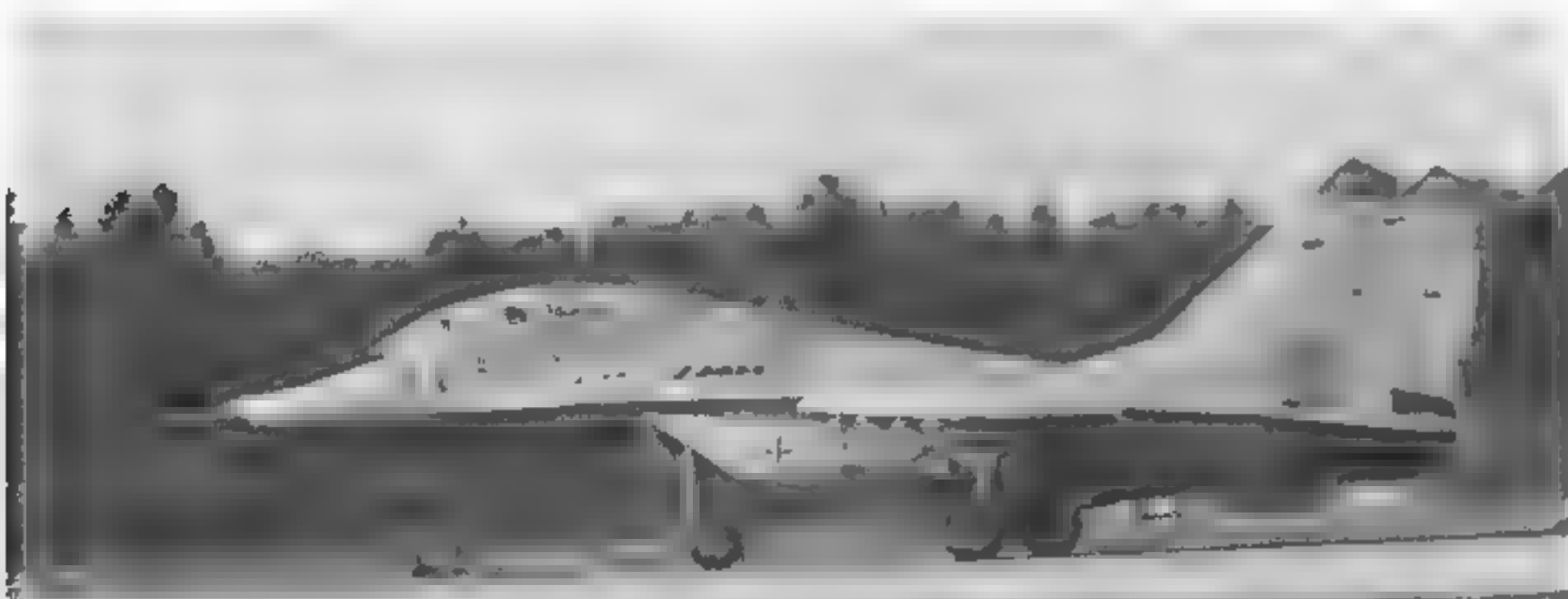




A German Air Force MiG-29UB Fulcrum B lifts off on an evaluation flight. The aircraft is in air superiority Gray camouflage with a Black anti-glare panel and radome. The former East German Air Force aircraft were taken over by the German Air Force during October of 1990. (Gunter Lippert/Soldat und Technik)

A MiG-29UB Fulcrum B of the German Air Force taxis out to begin another training sortie. The German Air Force absorbed the Fulcrums on strength with the former East German Air Force when the two countries reunited. (WTD-61)

All Fulcrums taken over by the German Air Force when Germany was reunited were given serial numbers that began with 29. The serial and insignia were painted in the position of the old East German tactical number after the numbers were painted out with a Light Blue paint. (WTD-61)





A line of Romanian Air Force Fulcrums. Red 23 is a MiG-29UB Fulcrum B while Red 48 and Red 47 are single seat MiG-29 Fulcrum As. The aircraft were on display at Bucuresti-Baneasa Air Base on 1 July 1990 for the first public showing of the Fulcrum in Romania.

A Romanian Air Force ground crew checks out a MiG-29UB during early Summer of 1990. The square object in the center of the canopy is the instructor's periscope. Both the front and back cockpits are equipped with rear view mirrors.

A ground crewman positions a boarding ladder against this Romanian Air Force MiG-29UB, Red 23, on the ramp at Kogalniceanu Air Base during early Summer of 1990. Red 23 was flown by the Adjunct to the Chief of the Air Force, MAJ GEN Volan, who was impressed with the Fulcrum's handling.





A ground crewman talks to the pilot of a Romanian Air Force MiG-29UB, Red 23, on the ramp at Bucuresti-Baneasa Air Base on 1 July 1990. The air show was originally scheduled for 17 June, but was postponed because of civil unrest in the country. (Urs Harnisch)



Fulcrums have been displayed at a number of Western air shows. This Fulcrum B, Blue 53, was displayed at the Paris Air Show. This aircraft was actually a MIG-OKB aircraft retained by the factory for tests, pilot training and display work. The tactical number was Blue with a thin white outline. (Urs Harnisch)

A Romanian Air Force MiG-29UB Fulcrum B, Red 15, rolls out on landing at Kogalniceanu Air Base during early Summer of 1990. This aircraft is one of two Fulcrum Bs currently in service with the Romanian Air Force. (Urs Harnisch)



This MiG-29UB was one of a pair of MIG-OKB aircraft that toured the United States. The aircraft was used to fly important official and media personnel during the tour. The tactical number was unusual in that it was carried on the fin, rather than on the air intake. (Urs Harnisch)



AIRCRAFT OF THE *GULF WAR*



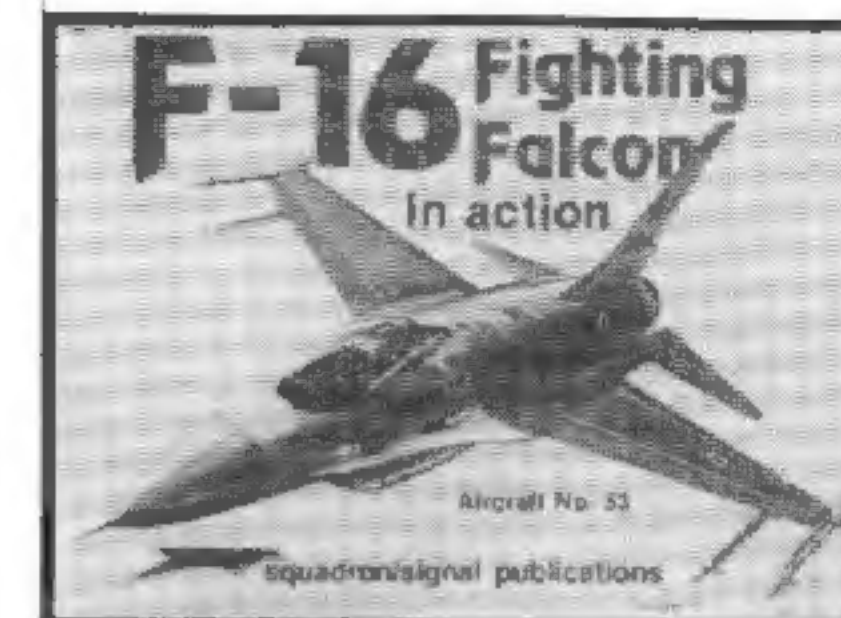
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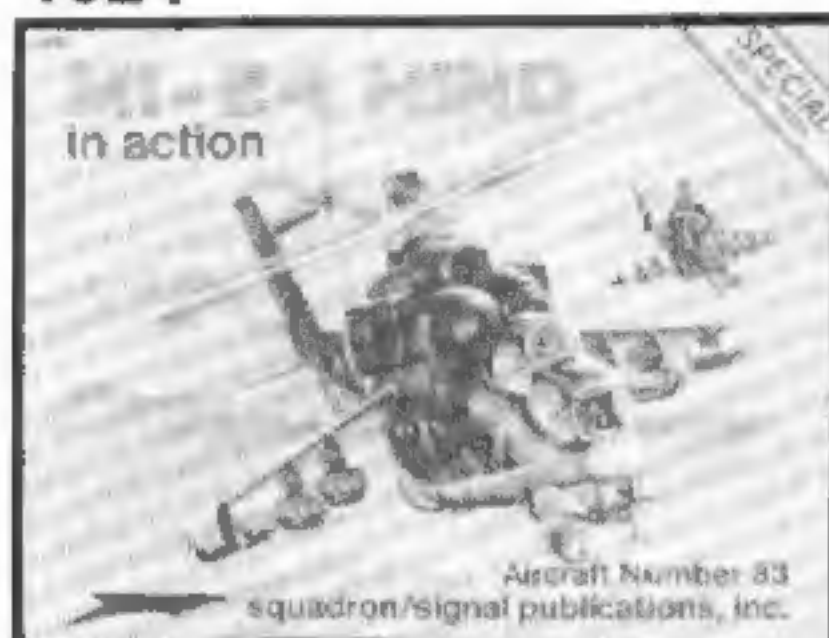
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squadron/signal publications



The East German Air Force painted this MIG-29 Fulcrum A in special markings to mark the last flight of the Fulcrum in East German service, as German reunification became a reality.



This MIG-29K has been modified with folding wingtips to serve as a prototype navalized Fulcrum. The aircraft took part in flight tests from the Soviet aircraft carrier, TBILISI in the Black Sea.